The Impact of Digital Transformation on the Western Balkans – Tackling the Challenges towards Political Stability and Economic Prosperity

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WB6+ digital transformation

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Publisher: digital WB6+[2]
c/o Deutsche Telekom AG
Friedrich-Ebert-Allee 140, 53113 Bonn, Germany
www.wb6.digital
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Publishing Date: 18 April 2018, Graz / Zagreb

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[2] The digital WB6+ Initiative was established in April 2017 by Deutsche Telekom, Telenor, Telekom Austria, EY, SAP as well as the Committee on Eastern European Economic Relations, Chambers Investment Forum, German-Croatian Chamber of Commerce, German-Serbian Chamber of Commerce, Chamber of Commerce and Industry of Serbia, Economic Chamber of Macedonia, Croatian Chamber of Economy, and Hrvatska Udruga Poslodavaca to foster digital transformation in the Western Balkans and facilitate the path towards the EU.

Foreword by Mariya Gabriel, Commissioner for Digital Economy & Society

I warmly welcome this interesting and important study on the impact of digital transformation on the Western Balkans. It really comes at the right time.
The internet and digital technologies are transforming our world. Digitalisation is a major driver for innovation, competitiveness, job creation and growth in all sectors. It opens up new opportunities, helping citizens and companies to get the best from the interconnected world. Digitalisation is not a choice anymore, but rather a necessity for businesses and economies around the world, in Europe and in the Western Balkans.

Electronic communications services and networks are key sectors to achieve economic and digital development; with the participation and goodwill of all concerned we can not only close the digital gap, but serve societies and economies at large, in order to - as the study rightly points out - "maximize the benefits, reduce costs, and seek to avoid the emergence of an insurmountable digital gap."

In an increasingly mobile world, being able to use your phone when you travel to the country next door is important. That is why I am pleased that we managed to eliminate roaming charges within the EU. This study shows why we need to bring down the cost of data and voice calls across borders with the Western Balkans too: access to internet, cross-border data exchange, and also personal data protection are becoming more and more important in the application-based economy.

The digital transformation provides an opportunity for the Western Balkans to learn from the experience of the EU in order to transform their economies into state of the art, modern, digital societies. Putting in place the reforms needed to benefit from digitalisation will lead to a substantial boost of the Western Balkan economies, and accelerate the path to the EU.
Thank you again for having conducted that valuable study.

Enjoy the read!

Executive Summary

Digital transformation is an opportunity for the Western Balkans to address some of the structural economic, political and social challenges of the region. This study outlines how the region is lagging behind in most measures of digital transformation, from the use of the internet and broadband technology, to the share of the economy by using digital technology, and the digital readiness of the public administrations and governments. In the coming years, global digital transformation will profoundly affect the Western Balkans: either the societies, economies, and governments will be unprepared, which will result in job losses, brain drain, and increasing economic divergence from the EU or if they are to be prepared, digital transformation will serve as a tool for catching up economically and socially and preparing the economies for a membership in the EU.

This study provides for a detailed analysis of the potential benefits of the regions' digital transformation and its broader economic, social, and political repercussions. It shows that digital transformation, including greater availability of digital infrastructure, a better regulatory framework and closer regional cooperation can have an important impact on economic growth and employment. In addition, digital transformation can help integrate previously marginalized population groups into the economy. Embracing e-governance can both advance the region's digital transformation and provide for rule-based, transparent administration and multi-stakeholder engagement in the policymaking process. These can substantially advance the European integration of the region and contribute to overcoming the deficiencies the region faces in terms of rule of law, corruption and dysfunctional market economies.

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1. Introduction

The digital transformation of the global economy is a process that will substantially impact economies, societies, and governance around the world in the coming decade. Being a global, multidimensional process, no economy or region can effectively isolate itself from this transformation. The challenge for the economies around the world lies in the preparation and the maximization of digital transformation benefits, while anticipating the challenges this process will pose.

The Western Balkans have to date been laggards in relative terms to some European and global digital frontrunners. In addition to individual efforts and actions, which run into danger of cementing a fragmented digital landscape, the level of regional digital cooperation offers much room for advancement. However, the significance of digital connectivity is only gradually receiving more attention.

Over recent years, particularly since the launch of the Berlin Process for the Western Balkans in 2014, there has been considerable focus on enhancing the infrastructure in the Western Balkans. This includes mostly road-building projects to close important gaps in the region in order to connect the economies with each other, but also to enhance larger European transit routes and contribute to internal links. Amidst this focus, there has been relatively limited interest until recently on improving the digital infrastructure and thus improving connectivity—with the region, with the economies of the region, and with Europe and the wider world.

Improvements in this field are less visible since either the reduction of the regulatory burden or the enhancement of the broadband capacity do not create the same kind of groundbreaking (figuratively and literally) attention as the opening of a new road. The significance of these invisible connections and their economic, social, and political repercussions are momentous, as this study shows.

The Western Balkans are facing multiple challenges. Economically, the economies of the region are lagging significantly behind not just the average of the EU, but also behind the economies of Central and Eastern Europe that joined the Union in 2004 and 2007. The living standard, as measured by GDP PPP stands at a quarter of developed European economies (like Austria and Germany), at a third of the Southern European economies (like Spain and Italy) and at the half of the Central European economies of the EU (Sanfey, Milatović, & Krešić, 2016). Achieving convergence with the EU has been slow and remains a significant challenge. In an optimistic scenario, convergence to the EU average in GDP will take 40 years, and 200 years in a pessimistic case (Muent, 2017). Such long-time horizons highlight the difficult economic position of the region and the absence of quick and easy fixes.

The prospect of EU membership is tangible for several economies within a decade (EC, 2018). However, this prospect does not encompass all of the Western Balkans, as at best two to four of the six aspiring

EU members will be able to join within a decade. Furthermore, membership in the EU does not imply full integration in terms of access to the more advanced aspects of European integration such as membership in the euro zone and the Schengen Area.

Most importantly, the economic and political integration of the Western Balkans into the EU is advanced, but incomplete. As the European Commission noted in its 2018 strategy, "[n]one of the Western Balkans can currently be considered a functioning market economy nor to have the capacity to cope with the competitive pressure and market forces in the union” (EC, 2018, p. 3). Thus, a substantial transformation of the economies will be required, despite an extended period of economic reform.

Change will not occur by itself, but requires considerable initiative and effort by the Western Balkan governments. As this study highlights, the digital transformation of the region can be an important pillar of this transformative dynamic. Currently, the Western Balkans are lagging behind digital transformation in comparison to the EU average and most its member states.[3] Overall, multiple studies have shown that digitization contributes to economic growth, increases in productivity and employment (OECD 2016, UNCTAD 2017). As this study shows, closing the digital gap in the Western Balkans provides for opportunities in terms of growth, job creation, as well as promoting good governance and addressing social inequalities, as well regional cooperation. To unlock the potential of digital transformation, governments of the Western Balkans primarily need to confront regulatory obstacles and challenges in the field of the rule of law. Furthermore, a more harmonized approach to digital transformation in the region and integration into the European Digital Single Market is needed. If the digital transformation of the region is not endeavored upon as part of the wider reform, integration and connectivity agenda, the Western Balkans risk being left behind and the convergence with the EU being further stymied. Digital transformation is well on its way, and it changes the way citizens work, interact with governments, inform themselves and interact. If the governments of the Western Balkans, together with their citizens and businesses do not engage with it, they risk being left behind, as “the digital and innovation gap between SEE and Western/Northern Europe will widen, leaving the Western Balkans as a 'second grade' region, with a high rate of out-flux of highly skilled experts and virtually no chance to profit from the Fourth Industrial Revolution” (Mondekar, 2017, 22).

The purpose of this study is to outline the state of digital transformation in the Western Balkans and assess the potential benefits of sustained regional commitment to advance the digital transformation by all relevant stakeholders, from regional governments to the EU and regional organizations and businesses.

[3] The digital sector already amounts to 6.2 percent of the EU’s GDP and 8 percent in the United States (Elmasry, Benni, Patel, & aus dem Moore, 2016).

First, the study will identify the current state of digital transformation in the Western Balkans. The region remains a laggard by most indicators in comparison to the EU average. This delay in digital transformation is closely linked to deficiencies in the regulatory framework, the political context and general business climate.

Next, the study explores the economic impact of an increased digital transformation of the region**.** The proposed digitalization index suggests a wide variety in the level of digitalization in the region, with Slovenia being a front-runner, followed by Croatia, Montenegro, Serbia, The Former Yugoslav Republic of Macedonia, Bosnia and Herzegovina, Albania, and then Kosovo*[4]. Overall, this study finds that 10 percent improvement in the index would increase GDP by 0.63 percent. This suggests that digital transformation can make an important contribution regarding the macroeconomic development of the region. The microeconomic and sectoral analysis confirms this pattern. Precisely, enhanced digital transformation has clear positive effects on productivity growth in different sectors, as well as on employment, in particular in the manufacturing sector.

In addition, the study highlights the multiplicative effects of investments in broadband infrastructure, which are needed in order to speed up the process of digital transformation in the region. The study also emphasizes how a more harmonized approach to digital transformation across the region could potentially lead to more intensive regional economic cooperation and integration. By doing so, greater regional digital harmonization would not only promote more intensive economic cooperation, but it would also help improve the region to attract investments.

Finally, the study explores the transformative effect of digital transformation on labor markets, suggesting that it will promote a shift of jobs toward a higher skilled workforce. It will further provide an increased access to jobs for often marginalized groups and increase new working arrangements that can help in balancing work-life arrangements, improving organization of work, and increasing labor productivity. Changes in the educational system and on-the-job training are going to be needed to match this shift and prepare citizens for changes that will take place as digital transformation gains strength.

In exploring the societal and political impact of digital transformation, this study shows how digital transformation can have a direct and indirect impact on governance and society, as well as on regional cooperation and the EU integration of the region. Through e-governance and the associated opportunity for more transparent decision-making and rule-based procedures that reduce opportunities for

[4] This designation is without prejudice to positions on status, and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.

corruption and can improve the speed and transparency of the public administration, digital transformation provides for an important tool to assist the convergence of the region with the EU and conditions for its membership.

2. Current State of Digital Transformation in the Western Balkans

In 2015, broadband internet became one of the vehicles of inclusive and sustainable development in the UN's Sustainable Development Goals.[5] At the same time, the EU has replaced the outdated Digital Agenda Policy with the Digital Single Market for Europe, pushing for the development of digital society. In line with the global developments, digital transformation is expected to play a vital role in spurring future sustainable growth in the Western Balkan region and contribute to regional cooperation and good governance.

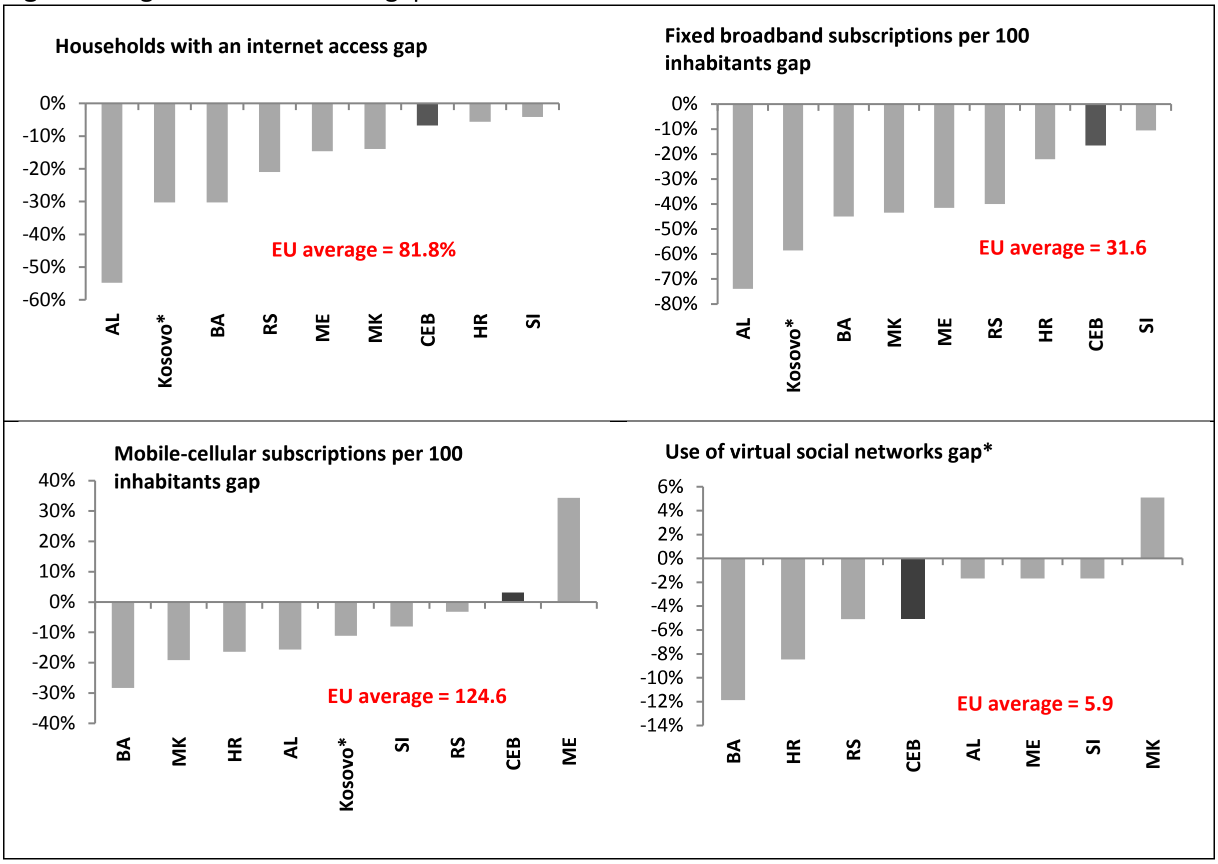
However, despite reaping numerous benefits, the current state of digital transformation in the Western Balkans shows that the region lags considerably behind EU averages with respect to all key indicators of digital transformation in 2016. In order to address this issue, we calculated digital transformation gaps for each Western Balkan economy in comparison to EU averages.[6] Results are partly presented in Figure 1.[7] These digital transformation gaps between the Western Balkans and the EU, which compare the values of digital transformation indicators to respective EU averages, suggest the level of digital transformation in Western Balkan economies also falls short relative to more propulsive regional peers in Central Europe and the Baltics (CEB).[8] These gaps are particularly large for Albania, Bosnia and Herzegovina, and Kosovo*, which are marked by significant deviation from EU averages both in infrastructure and individual use indicators. On the other hand, Slovenia and Croatia more successfully converge to EU levels in case of individual use indicators, when compared to the digital infrastructure indicators.

Slovenia and Croatia are ahead of their Central European and Baltic peers in terms of the proportion of households with computer and internet access at home. Albania has the weakest performance in these indicators, lagging behind EU average by more than 50 percent. A comparative assessment of use of mobile cellular subscriptions shows Montenegro as the strongest performer, exceeding the EU average. High mobile penetration in Montenegro can be partly explained by a significant number of tourists visiting the economy seasonally and the tendency of subscribers of having multiple prepaid

[5] 2030 Agenda for Sustainable Development.
[6] We use digital transformation gaps to compare the level of digital transformation in the Western Balkans and the EU. Digital transformation gaps for indicators of individual use, affordability and infrastructure, are calculated relative to the average of the EU in a way that each indicator is benchmarked relative to the EU average: $Digital\ transformation\ gap_{i,t} = \frac{Indicator_{i,t}}{Average\ (Indicator)_{EU,t}}$*100. A positive gap means the indicator of an economy is above the EU average and vice versa.
[7] Note that additional digital transformation gap indicators (households with a computer gap, internet users gap, international internet bandwidth per internet user gap, fixed broadband internet monthly subscription gap) are presented in Figure 1a in Appendix A.
[8] Central Europe and the Baltics (CEB) include Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia.

cards. Additionally, due to investment in Long-Term Evolution (LTE) technologies, the mobile broadband has become a viable alternative to fixed-line broadband in many rural areas in Montenegro.

Figure 1. Digital transformation gaps in the Western Balkans in 2016



Notes: *The indicator derived from the Global Information Technology Report for 2016- source is the World Economic Forum (2016a), Executive Opinion Survey, Scale from 1–7 (in your country, how widely are virtual social networks used [e.g., Facebook, Twitter, LinkedIn])? [1 = not at all used; 7 = used extensively]; CEB stands for Central Europe and the Baltics; MK stands for The Former Yugoslav Republic of Macedonia.
Source: ITU (2017b), Pew Research Center (2015), Agency of Statistics of Kosovo*(2016) and Regulatory Authority of Electronic and Postal Communications for Kosovo* (RAEPC).

Western Balkan economies lag behind the EU average the least as regards the use of virtual social networks—with four economies being more advanced when compared to its Central European and Baltic peers. The Former Yugoslav Republic of Macedonia is the most advanced in social networks use, outperforming the EU average by five percent. Those results are confirmed with the latest available data of the Internet World Stats for June 2017, which measure Facebook penetration rate (i.e., the number of Facebook users compared to total population). According to the Internet World Stats, Montenegro, Albania, The Former Yugoslav Republic of Macedonia, and Kosovo* remain the regional leaders in Facebook use, with penetration rates exceeding 45 percent. Such statistics are in line with recent surveys that suggest that online users in emerging and developing economies are more likely to use social media, compared to those in the developed world (Pew Research Center, 2015). Although the results were partly explained by a more pronounced need for social interaction of population in less developed economies, one might argue that an increase in connectivity in developing economies, regardless of the initial motivation of users, will undoubtedly engage people to take a greater part in the digital economy. The analysis of fixed broadband penetration in 2016 shows that most Western Balkan economies have not yet reached the level of broadband penetration of their EU and CEB peers. The infrastructure gap, measured by the international internet bandwidth per internet user indicator,[9] also reveals that all Western Balkan economies are still well behind the EU.

To sum up, Western Balkan economies significantly lag behind EU averages as far as digital infrastructure in concerned, while indicators of individual use show less pronounced deviations from EU averages in general. Nevertheless, there is a difference between the observed economies with regard to the individual use indicators as well. While Albania, Bosnia and Herzegovina, and Kosovo* experience the largest gaps in comparison to EU averages of individual use indicators, Slovenia and Croatia are most successful in converging to EU levels. At the same time, the lagging behind EU levels is least pronounced in the use of virtual social networks. The inclination of population in Western Balkan economies toward the use of social networks could be seen as a vehicle of catching up at the level of development of digital economy and economy as a whole through enhancing commercial and entrepreneurial activities.

2.1. The state of digital transformation and economic development in the Western Balkans

In order to measure the current state of digital transformation in relationship to the overall economic development, we paired selected digital transformation indicators and GDP per capita levels for all EU and Western Balkan economies. The results are presented in Figure 2a in the Appendix A. The results indicate that the individual use in European economies is positively correlated with the economic development. Thereby, individual use in the overall Western Balkan economies is in line with what one would expect given their level of economic development. Merely Albania and Bosnia and Herzegovina are standing out for lagging behind. Internet bandwidth is also positively correlated with economic development. For Western Balkan economies, it is lower than expected for respective levels of development for all economies except Slovenia and Montenegro. This can be explained to some extent with generally low levels of connectivity, a fragmented telecom infrastructure and recent political uncertainty and instability, which constrained larger capacity and investments in the region.

We found a negative relationship between the households with internet access and the share of the revenues, which telecom companies invest in the infrastructure. This is borne out by the negative slope

[9] The international internet bandwidth per internet user gap is presented in Figure 1a in the Appendix A.

of regression line in graph 2a.5 in Appendix A. Here Albania stands out as a bright example of good practices, possibly due to the fact that investment in fixed-line infrastructure is being encouraged by the regulator through amended access measures and by the government through its own funding programs (BuddeComm Intelligence Report, 2016). At the same time, Bosnia and Herzegovina, Serbia, and Montenegro are experiencing underinvestment relative to their level of household internet access.

2.2. Overall obstacles to digital transformation

In order to get a more detailed insight in obstacles to digital transformation in the Western Balkan economies, we use the Network Readiness Index.[10.] The main motivation for analyzing the Network Readiness Index stems from its global coverage, which allows us to compare all Western Balkan economies, except Kosovo*. On the other hand, we also report DESI[11], which is available for Croatia and Slovenia only, being an index, which covers EU member states. Besides the coverage of the economies, the two indices differ in the source of the data employed in the analysis, i.e. DESI relies on 30 statistical indicators, while the Network Readiness Index equally combines statistical and survey data.

The Network Readiness Index and its components are presented in Figure 2. The Network Readiness index is highest for Slovenia, The Former Yugoslav Republic of Macedonia, and Croatia, although in all three cases still below the EU average. While deviations from EU levels have been registered for almost all index pillars, the analysis of the network readiness confirms infrastructure, regulatory and political environment, among weakest points of digital transformation of the Western Balkans. The latter has been particularly driven by strong divergence of laws related to ICTs in all economies except The Former Yugoslav Republic of Macedonia and Slovenia. Interestingly, those two economies were among the first in the region to adopt the broadband policies (see Appendix A). The political and regulatory environment in Western Balkan economies in 2016 was burdened by the inefficiency of the legal system and a lack of independence in judiciary, according to the Network Readiness Index values. This is corroborated by a number of other reports and studies, not least the European Commission reports

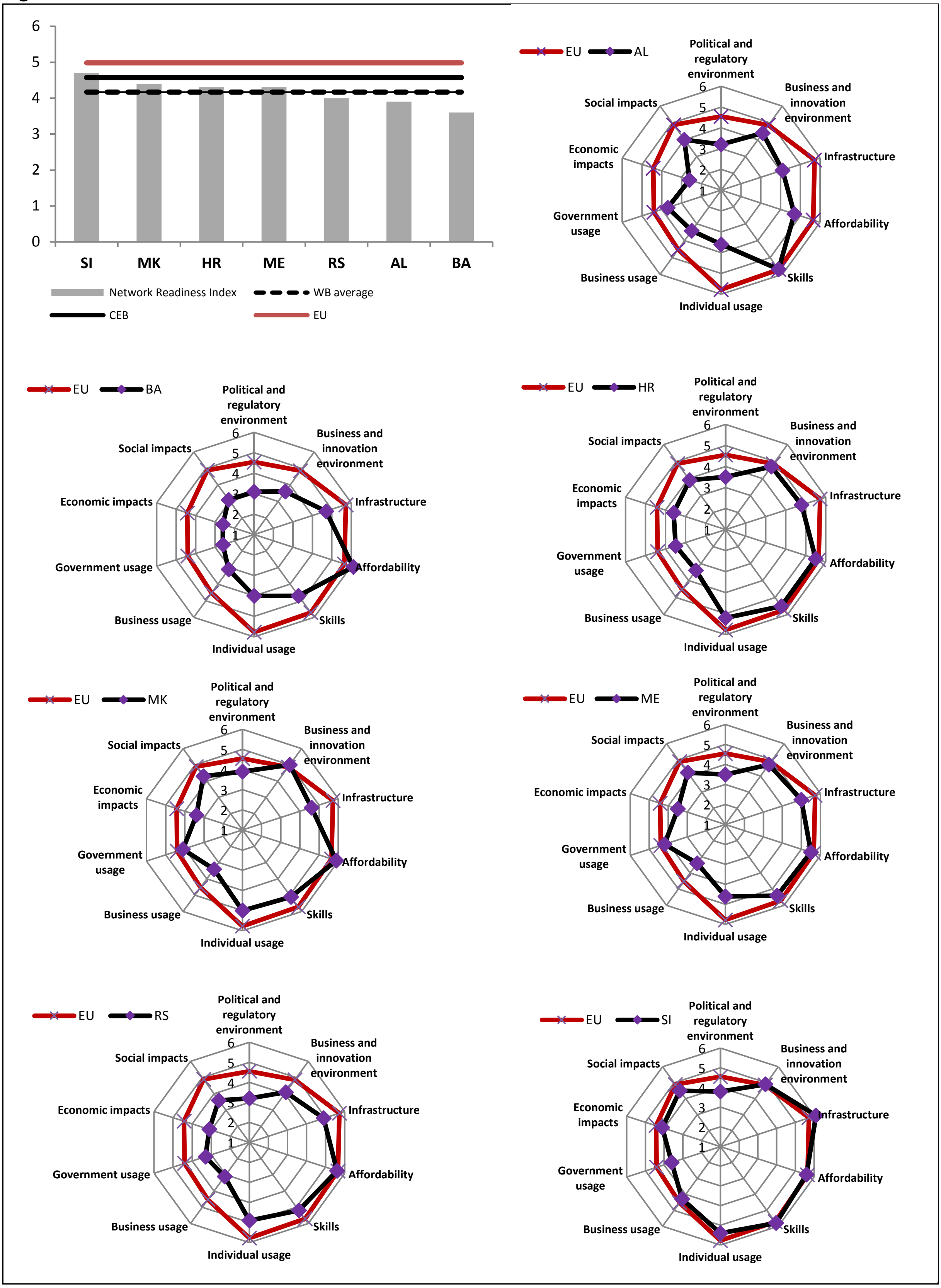
[10] The Network Readiness Index measures the performance of 139 economies in leveraging information and communications technologies to boost competitiveness, innovation and well-being. It is a composite indicator made up of four main categories (Environment, Readiness, Usage and Impact Sub-indices), 10 subcategories (pillars), and 53 individual indicators distributed across the different pillars. Scale ranges from 1 (worst) to 7 (best). It has been published by the World Economic Forum since 2002. The main providers of data employed in index are the ITU, UNESCO and other UN agencies, the World Bank, and the World Economic Forum's Executive Opinion Survey.

[11] Digital Economy and Society Index (DESI) is a composite index that tracks the evolution of EU member states across five main dimensions: Connectivity, Human Capital, Use of Internet, Integration of Digital Technology, Digital Public Services. It includes some 30 relevant indicators on digital performance of EU member states. It has been published since 2014. DESI is based on the statistical data collected by the European Commission's Directorate for Communication Networks, Content, and Technology and the IHS company.

on the Western Balkans.[12] Such findings are troublesome; keeping in mind that the adequate regulation and infrastructure is needed to facilitate investments, i.e., weak and unstable regulatory framework constitutes a poor business climate that undermines investment incentives in electronic communications infrastructure.

[12] See European Commission, 2016 *Communication on EU Enlargement Policy*, 9.11.2016, as well as individual country reports available at https://ec.europa.eu/neighbourhood-enlargement/countries/package_en. See also Nikola Burazer, Krisela Hackaj, Ardita Shehaj, Ivan Stefanovski, *Democracy in Progress Shadow Report on Political Copenhagen criteria in Western Balkans EU Candidate States.* Belgrade: Centar savremene politike, 2017; Florian Bieber, Marko Kmezić (eds), *The Crisis of Democracy in the Western Balkans. An Anatomy of Stabilitocracy and the Limits of EU Democracy Promotion*. Belgrade: Balkans in Europe Policy Advisory Group, 2017.

Figure 2. Network readiness index in 2016



Note: MK stands for The Former Yugoslav Republic of Macedonia.
Source: World Economic Forum (2016).

2.3. Regulatory obstacles

The challenges arising from regulatory obstacles are also borne out by a survey conducted among telecommunications companies in the Western Balkans, as indicated in Table 1. In particular, the use of public land for infrastructure deployment is difficult or very difficult in a majority of Western Balkan economies. Obtaining permits needed for infrastructure deployment is especially challenging and corresponds well with the general ease or difficulty of doing business in these economies. All economies also charge a host of parafiscal charges related to the investments in electronic communications infrastructure, which significanly increase the outlays for the deployment of new infrastructure (for details see the Table 2a in the Appendix A).

Table 1. Impediments to deployment of new electronic communications infrastructure

Economy	Easiness of using public land and infrastructure*	Number of months to get permits for civil works	Other impediments
AL	3	12	-
BA	1	12–24	Legal framework; unsynchronized local regulation; long time to get license for 4G
HR	1–2	12–24	Unreliable cadaster and land registry records; high fees for the use of public and/or private land; long administrative procedures; unharmonized interpretations of laws and bylaws in various obligatory administrative proceedings;
MK[13]	2–4	3 or more	Procedures for building permits; regulation of legal property issue; no urban plans for entire territory of MK; negative business cases for many rural and suburban areas
ME	1	6	Specifics of telecommunications facilities are not recognized by the Law on Spatial Development resulting in lengthy procedures for obtaining necessary permits**
RS	2	6	Long time to issue permits for laying optical cable; long-term return of investments.

Notes: *Scale from 1 (very difficult) to 5 (very easy); ** Montenegro adopted the new "Act on Spatial Development and Constructions" in end-September 2017 which eliminates building permits.
Source: Western Balkan telecommunications companies survey (authors' construction).

These findings are in line with the existing research, e.g. the World Bank report has found that the costly investments for broadband deployment, consisting at 70–80 percent of costly civil works and lengthy permit granting procedures, constitute the main constraints to the development of national or regional broadband connectivity.[14]

[13] The Former Yugoslav Republic of Macedonia.
[14] See more in the International Bank for Reconstruction and Development (IBRD) and World Bank (2017). *Western Balkans: Regional economic integration issues notes*. Washington, DC: International Bank for Reconstruction and Development (IBRD) and World Bank.

2.4. Conclusion

Wrapping up, our analysis of available data and indices covering Western Balkan economies revealed significant gaps in digital transformation indicators in comparison to EU levels. The region is lagging behind its EU peers in terms of individual use and infrastructure indicators, the gap being less pronounced in the use area. Still, some differences were spotted within the Western Balkans economies — Slovenia and Croatia came closest to EU digital levels, while Albania, Bosnia and Herzegovina, and Kosovo* are facing the longest path ahead. Less developed economies can be the leaders in use of social networks, which proved to be the case in this group too. Social networks both can help leapfrog access to media content and economic opportunity, but also bears the risk of being abused for spreading unverified content and undermining social cohesion, as we discuss in greater detail in section 4.2. Connectivity can be a strong vehicle of fostering digital transformation and economic growth, but one should not underestimate the existing infrastructure gaps of Western Balkans compared to EU. This can be explained to some extent with fragmented electronic communication infrastructure, low economic growth prospects and political instability, which have discouraged investments in the region. Moreover, our analyses confirm that the investments in digital infrastructure in Western Balkan economies are constrained by a weak and unstable regulatory framework, which leads to a poor business climate. Further progress is needed in the area of business climate improvement, parafiscal charges reduction and facilitated use of public land, in order to overcome the observed trends and stipulate digital infrastructure investments, especially in broadband, as the region's demand for broadband is projected to grow, driven by population and future economic growth.

3. Economic Impact of Digital Transformation in Western Balkan Economies

3.1. Macroeconomic effects of digital transformation

In this section, we analyze the macroeconomic effects of digital transformation. Therefore, we use a large dataset of 217 economies and territories that spans over 12 years, from 2005 to 2016.[15] In order to adequately capture the developments in Western Balkan economies, we introduce a global multifaceted measure of digital transformation, the digitalization index, as proposed by Sabbagh et al. (2012) and Katz and Koutroumpis (2013).

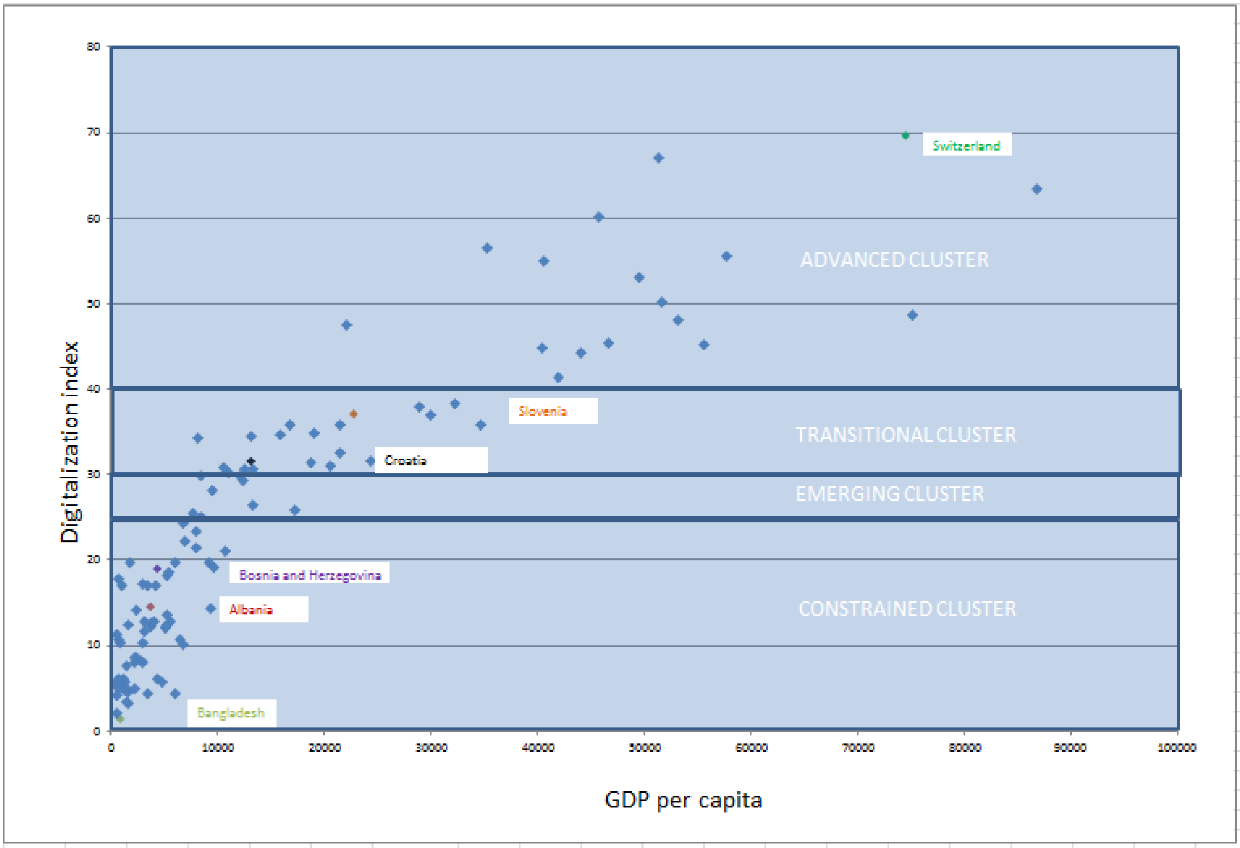
3.1.1. Digitalization index

The index consists of 16 indicators divided into six groups of digitalization categories: affordability, infrastructure reliability, network access, capacity, use, and human capital. Affordability measures the relative access costs for telephone, mobile, and fixed broadband networks. Infrastructure reliability derives from the amount of investments in telecommunications in a country adjusted for the number of users. Network access refers to the ownership of devices that enable access as well as to the adoption of mobile and broadband networks. Capacity measures broadband speed and internet bandwidth. Use represents both public and private utilization of digitalization, while human capital proxies skills essential for the development of digital transformation.[16]

The digitalization index is based on the factor analysis[17] of all 16 indicators. The biggest weight, or factor, of the index is attached to capacity, use, and infrastructure reliability indicators, followed by affordability indicators. For illustration purposes, in 2014, Switzerland was the leading economy according to the digitalization index, followed by Norway, the Netherlands, and Denmark, while Ethiopia, Bangladesh, and Togo were the laggards. Figure 3 presents all of the economies from the sample for which we were able to calculate the digitalization index, including some Western Balkan economies.[18]

Figure 3. Digitalization index and GDP per capita

[15] Note that digital transformation is reflected in different aspects such as infrastructure, network access, affordability etc. The multitude of different candidate variables that measure digital transformation makes a straightforward approximation of the overall state of digital transformation cumbersome.
[16] All the indicators with the corresponding categories and variable sources can be found in Table 1b of the Appendix B.
[17] Factor analysis methodology and estimation results are described in more detail in the Appendix B.
[18] Unfortunately, in this part of the analysis we were not able to calculate the index for Kosovo*, The Former Yugoslav Republic of Macedonia, Montenegro, and Serbia, because the data for all of the 16 components are not available for those four economies.



Notes: Both values are averages for the 2005–2016 period; two outliers (Monaco and Kuwait) are excluded from the visual representation; cluster definitions were taken from Katz and Koutroumpis (2013).
Source: Authors' calculations and Katz and Koutroumpis (2013).

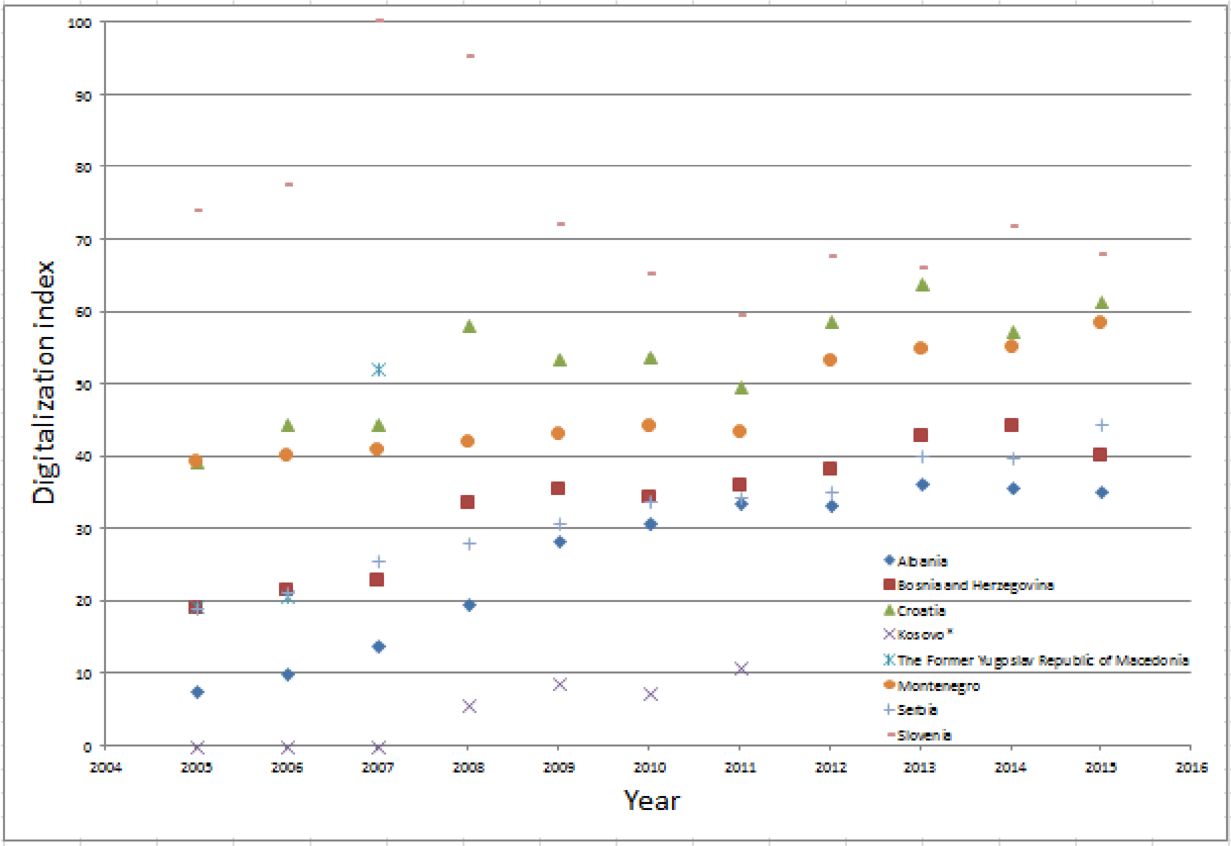
Slovenia had the highest average value of the index in the examined period, followed by Croatia, Bosnia and Herzegovina, and Albania. Slovenia and Croatia were in the 30–40 range of the index, or the transitional cluster (as defined in Katz & Koutroumpis, 2013), Bosnia and Herzegovina and Albania on average stood in the 0–25 category, or in the constrained cluster of economies. However, taking into account time dynamics, index values in all economies moved upwards. In 2015 for example, Bosnia and Herzegovina moved closer to the emerging cluster of economies, while Slovenia separates the transitional from the advanced cluster of economies.

A truncated version of the digitalization index for the Western Balkans, ranked by the value of the index in the 2005–2015[19] time period, allows the inclusion of Serbia, Montenegro, The Former Yugoslav Republic of Macedonia and Kosovo* (Figure 4).[20] The regional index suggests that Slovenia is digitally the most advanced economy in the sample, followed by Croatia, Montenegro, Serbia, The Former

[19] 2016 is left out due to missing data for most of the indicators in all Western Balkan economies.
[20] The index is constructed as before, with the difference that we omit four components: fixed broadband internet monthly subscription adjusted for GDP per capita, percentage of households with a computer, e-government web measure index, and human capital index. As demonstrated by Figure 1b in the Appendix, the truncated

Yugoslav Republic of Macedonia, Bosnia and Herzegovina, Albania, and then Kosovo*. Montenegro very much follows the dynamics of the index for Croatia, although its value is always below Croatia's. Serbia and Bosnia and Herzegovina go hand in hand, and although Albania reveals very similar dynamics, it is lagging behind both.

Figure 4. Truncated digitalization index



Source: Authors' calculations.

Kosovo* is the clear laggard in the region, at least up to 2011, the period until the data are available. Data for The Former Yugoslav Republic of Macedonia are unfortunately limited and erratic, as data are available for only three years, 2005–2007. In 2005 and 2006, the index value corresponded to that recorded for Bosnia and Herzegovina, but in 2007 the index jumped even above the value for Croatia. We believe, however, that this accounts entirely for a large one-off telecommunications investment in 2007. We can assume that the ranking for The Former Yugoslav Republic of Macedonia did not persist in the years after, and that it probably continued to follow the dynamics of the index for Bosnia and Herzegovina.

version of the index follows the dynamics of the "full-indicator" index for Albania, Bosnia and Herzegovina, Croatia, and Slovenia, making our "truncated" approach convincing and reliable.

3.1.2. Impact of digital transformation on economic output

To measure the effect of digital transformation on gross domestic product (GDP), we use the newly constructed digitalization index as a proxy for technology progress stipulated by the state of digital transformation. Technology progress is an irreplaceable input in the classic production function that describes GDP output as a function of the aforementioned technology progress, capital, and labor. We use an endogenous growth model described by $Y = A(t)K^{1-b}L^{b}$ where Y stands for GDP, K for gross fixed capital formation, L for the labor force, and A(t) presents technology progress, or the digitalization index (D) in our case.[21] The equation we estimate is the following:

$$\ln(GDP_{it}) = \alpha_1 \ln(K_{it}) + \alpha_2 \ln(L_{it}) + \alpha_3 \ln(D_{it}) + \varepsilon_{it} \quad (1)$$

The subscript *it* represents economy *i* in a specific year *t*, while ε_{it} is the error term, or the part of GDP not explained by the three dependent variables. The parameter of interest is α_3, as it captures the effect of digital transformation on the GDP. Precisely, it represents the GDP's elasticity to digital transformation implying that a ten percent increase in the digitalization index results in an average GDP increase of 0.47 percent (Table 2). Following Katz and Koutroumpis (2013), we also calculate the compounded annual growth rate (CAGR)[22] for an 'average' economy in our sample for the 2005–2016 period. CAGR reflects in this case the contribution of digital transformation to overall GDP growth in any given period. From our dataset we have chosen a economy with a moderate ten percent increase in the value of the digitalization index to represent an average economy for which we report the CAGR which we calculated at 0.8 percent. As the GDP at market prices for the 'average' economy increased by 5.2 percent in the period examined, and the value of the digitalization index by ten percent, we can conclude that digital transformation was responsible for as much as 14.9 percent of the overall 'average' economy's GDP growth (roughly 0.8/5.2*100).

[21] As the digitalization index is composed of indicators possibly endogenous to the GDP (the independent variable), in the analysis we control for economy and year fixed effects to take into account idiosyncratic characteristics of different economies and different time periods. We believe that by these two-dimensional fixed effects we mitigate endogeneity problems.

[22] CAGR is defined in the Appendix B.

Table 2. Estimation results for the effect of digital transformation on GDP

Dependent variable: GDP	Estimation results	
	Whole sample, full version of the index	Western Balkans, truncated version of the index
Fixed capital stock (K)	+0.417%	+0.309%
Labor (L)	+0.276%	Not significant
Digitalization (D)	+0.047%	+0.063%
Observations	205	73
Adjusted R-squared	0.99	0.99

Note: Standard errors clustered by economies; fixed effect panel data estimator was used for model estimation; we control for the economy and year fixed effects to take into account idiosyncratic characteristics of different economies and different time periods.
Source: Authors' calculations.

In order to isolate the effect of digital transformation on the Western Balkans, we repeat the same estimation approach, but this time using the "truncated" version of the index, as this is the only case in which we have all Western Balkan economies in the sample. The third column of Table 2 suggests that a ten percent increase in the index has an average effect of 0.63 percent on GDP. The compounded annual growth rate for an 'average' Western Balkan economy, i.e. one that had a ten percent increase in the value of the index in one year, then corresponds to roughly 0.4 percent. As the 'average' Western Balkan economy increased its GDP at market prices by 22.3 percent, we can conclude that digital transformation accounts for 1.8 percent to the overall economy's GDP growth.

Although the economic impact of a compounded index of digitalization is informative and attempts to measure the heterogeneous and intertwined effects of different digitalization on GDP, it is also useful to take on a disaggregated view showing how some of the index components affect the GDP. We therefore rerun our estimation by replacing the digitalization index with the share of population with a computer, share of population that uses the internet, broadband tariff adjusted for GDP per capita, or mobile network access. The results are presented in Table 3 suggesting that computer share and internet use have roughly the same effects each being stronger than the overall digitalization index that is shown in Table 2. As expected, the price customers pay for broadband use has a negative effect, implying costs are a constraining factor on GDP growth. We have also included a measure of mobile network access in order to demonstrate that the bare possession of devices without widespread network access does not help growth as much as the combination of the two. While the coefficient for the share of computers amounts to 0.075 percent, the one for mobile network access is as high as 0.238 percent (implying that a ten percent increase in the share of population with mobile network access is associated with a 2.38 percent GDP growth).

Table 3. Estimation results for the effect of digital transformation on GDP

Dependent variable:	Whole sample				Western Balkan		
GDP	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)	Model (6)	Model (7)
Fixed capital stock (K)	+0.402%	+0.402%	+0.507%	+0.510%	+0.240%	+0.310%	+0.327%
Labor (L)	+0.339%	+0.187%	Not significant	Not significant	+0.762%	Not significant	Not significant
Computer share	+0.075%				+0.164%		
Internet use		+0.063%				+0.065%	
Broadband tariff			-0.090%				
Mobile network				+0.238%			+1.708%
Observations	1,624	1,533	506	576	79	82	69
Adjusted R-squared	0.99	0.99	0.99	0.99	0.99	0.99	0.99

Note: Standard errors clustered by economies; fixed effect panel data estimator was used for model estimation; we control for the economy and year fixed effects to take into account idiosyncratic characteristics of different economies and different time periods.
Source: Authors' calculations.

For some of the main digital transformation measures, the effect on the GDP is much stronger in Western Balkan economies than in the whole sample. For example, while a ten percent increase in the share of population with mobile network access increases GDP by 2.38 percent worldwide, in the Western Balkans the effect is roughly seven times higher, or 17.08 percent.[23] For the share of population with a computer and internet use, the effects are also stronger in the Western Balkans, for a ten percent increase in the digitalization measure, GDP increases by 1.64 and 0.65 percent respectively. Thus, this additional economic growth can contribute to the convergence of the Western Balkans with EU-averages. This potential is not only important in terms of the economic implications, but also the ability of the economies in the region to join the European Union, as well as potential indirect effects on social transformation.

[23] Possibly due to the exceptionally strong increase of mobile network access exhibited by Kosovo*.

3.2. Sectoral and microeconomic effects of digital transformation

In this section, we explore the effects of the overall digital transformation on certain microeconomic outcomes (productivity and employment) in six Western Balkan economies (Slovenia, Croatia, Serbia, Bosnia Herzegovina, Montenegro, and The Former Yugoslav Republic of Macedonia).[24] The production function approach set out in section 3.1. is applied to the data on more than 159 thousand firms in the 2010–2015 period. We use the digitalization index in order to assess the impact of digital transformation on productivity and the number of employees in a given Western Balkan economy.[25] We also assess the impact of four specific aspects of digital transformation on productivity and employment: broadband speed, monthly use allowances, the degree of broadband penetration, and the affordability of broadband access.[26] The manufacturing and service sectors are analyzed separately[27]. The varying effects of digital infrastructure with respect to technological intensity and location of firms are also examined.[28] The primary aim of the analysis presented in this section is to investigate how productivity and employment among Western Balkan firms differ with respect to the levels of overall digitalization. In addition, we want to establish how productivity and employment among Western Balkans firms differ with respect to broadband speeds, monthly use allowances, degrees of broadband penetration, and affordability of broadband access these firms face in their everyday business activities.[29]

Digital technologies are important for firm productivity and employment. Their advances enable easier coordination of activities, faster exchange of information and new trajectories of learning. Electronic supply chain and customer relationship management, VoIP conferencing and e-banking are some examples of broadband applications that enhance knowledge management, administrative efficiency

[24] The firm-level data for Albania and Kosovo* were not available.

[25] At different levels of aggregation, one is likely to obtain different results with respect to digital infrastructure indices (Kretschmer, 2012).

[26] Broadband speed is measured with two indicators, the access to speeds of at least 10mbit/s and the international bandwidth of the economy per capita in each year. Mack (2014b) defines broadband speed of 10 mbit/s as minimum technical requirement for use of applications such as video-conferencing, e-learning or online presentations. For this reason, broadband speed is measured with a categorical variable that takes the value of 1 for user with access to at least 10 mbit/s broadband speed and 0 otherwise. International bandwidth of the economy per capita is measured with a maximum speed guaranteed to users from a particular economy in international network. Monthly user allowance is measured with a categorical variable that takes the value of 1 if unlimited traffic allowance is provided, 0 otherwise. The degree of broadband penetration enters the model as a proportion of households with access to broadband, while the affordability of broadband is measured with monthly price per 1GB package. All aforementioned indices are constructed on the basis of data obtained from the ITU database.

[27] In order to do that, we use the between-effect panel estimator which places emphasis on a cross-sectional variation between units (firms, industries, economies etc.), which is coherent with properties of our sample (strong variability among firms and little or no variability of digitalization measures over time). The between-effects panel estimator with controls for country, year, and sectoral technology intensity effects is applied.

[28] For explanation of model construction, dataset characteristics and methodology, see Appendix C.

[29] For detailed explanation of the model, see the Appendix C.

and innovations in modern firms (David, 1990; Jovanovic & Rousseau, 2005; Majumdar, Carare, & Chang, 2009; Mack, 2014a). Digital learning improves the skills of the workforce and enables a better match between employers and workers on the labor market. Access to broadband enables remote coordination of firm activities and paves the way for integration of domestic firms in international production value chains.

The effects of digital technologies are unevenly distributed across sectors and geographic areas. For instance, the effects of broadband deployment are generally stronger in more technology- and knowledge-intensive segments of the economy. The access to digital infrastructure reduces the need for face-to-face interactions and cuts time, transportation and distribution costs (Mack, 2014b). This, in turn, leads to the creation of electronically rather than spatially linked network effects, which are particularly strong in less urbanized and rural areas (Kim & Orazem, 2012). The realization of all of the above effects, however, depends on the quality of the underlying infrastructure of which the most important are broadband speeds and sufficiently large data allowances (Bertschek, Cerquera, & Klein, 2013; Haller & Lyons, 2015).

3.2.1. Impact of digital transformation on productivity and employment

In line with the previous section, our findings reveal that more intensive digital transformation is associated with increased productivity of Western Balkan firms (Table 4). An increase of the digitalization index by 1 percent thus corresponds to about 0.67 and 2.12 percent greater productivity in the services sector and manufacturing sector, respectively. There is also some evidence that more intensive digital transformation is associated with new job creation in the Western Balkan manufacturing sector, as a 1 percent increase in the level of digital transformation roughly corresponds to a 1.16 percent increase in employment. This increase matters economically, socially and politically, as the economies of the Western Balkans are marked by high levels of labor migration to the EU and political dissatisfaction fed by high unemployment, especially among better education and younger population groups. Thus enhancing employment in the digital sector and other domains linked to it can contribute to greater social and political stability in the region.

Table 4. Impact of digital transformation on productivity and employment, key findings[30]

Sector	Manufacturing		Services	
Variables	Productivity	Employment	Productivity	Employment
Digitalization index	+2.12%	+1.16%	+0.67%	Not significant

Notes: Between-effect panel data estimator that places emphasis on cross-sectional variation between units (firms, industries, economies) is used; controls for economy effects, cross-sectional (annual) shocks that may affect all units and differences in technological intensity are applied.

[30] Table 2c in the Appendix C provides full estimation results.

Source: Authors' calculations.

Apart from the overall microeconomic and sectoral impact of digitalization progress, we are also interested in the impact of specific digitalization features in the Western Balkans, as these findings would enable us to pinpoint the most productivity and employment-enhancing features of digital transformation. This is key for the understanding of the relationship between digital transformation and firm performance in the region. The analysis is therefore focused on four aspects of digital transformation, namely, broadband speed, use allowance, affordability, and penetration rate.

Higher broadband speeds, according to this analysis, are associated with increased productivity and employment of Western Balkan firms (Table 5). Firms in the manufacturing sector that have access to broadband speeds of at least 10 mbit/s or higher, on average exhibit about 50 percent higher productivity levels than manufacturing firms without that access. In the service sector, access to broadband speeds of at least 10mbit/s increases the productivity of firms by about 25 percent.[31] New technologies enable new modes of learning and generate a demand for novel, mostly high-skilled, human capital. Access to faster broadband corresponds to on average 1.5 times higher employment in the manufacturing sector and about 36 percent in the service sector. Positive effects of increases in international bandwidth are found both in the manufacturing and services firms.

Table 5. Impact of digital transformation components on productivity and employment, key findings[32]

Sector	Manufacturing		Services	
Independent/Dependent variables	Productivity	Employment	Productivity	Employment
Broadband speed (> 10 mbit/s)	+49%	+150%	+25%	+36%
International bandwidth	+0.13%	+0.83%	+0.10%	+0.30%
User allowance	+17%	+97%	+9%	+20%
Monthly costs of broadband	Not significant	+1.37%	Not significant	+0.63%
Penetration rate of broadband	+0.14%	+0.63%	Not significant	Not significant

Notes: Between-effect panel data estimator that places emphasis on cross-sectional variation between units (firms, industries, economies) is used; controls for country effects, cross-sectional (annual) shocks that may affect all units and differences in technological intensity are applied; broadband speed is measured with a categorical variable that takes the value of 1 for a user with access to at least 10 mbit/s broadband speed and 0 otherwise; international bandwidth is measured by the international bandwidth of the economy per capita in each year; user allowance is measured with categorical variable that takes the value of 1 if unlimited traffic allowance is provided, 0 otherwise, while the affordability of broadband is measured with monthly price of 1GB package.
Source: Authors' calculations.

[31] In log linear specifications as ours, the effect of categorical variables on the dependent variable is obtained as an exponential of the obtained coefficient.
[32] Table 3c in the Appendix C provides full estimation results.

Flat internet provision ***proxied by the variable "user allowance"*** is associated with a 9 percent higher productivity of Western Balkan services firms and 17 percent in manufacturing firms. As noted previously, broadband speed and higher data use allowances enable the use of broadband applications and migration of supply chain and customer relationship management practices to digital platforms. Unlimited data use corresponds to 90 percent higher employment in the manufacturing sector and to about one fifth higher employment in the service sector.

In the Western Balkan manufacturing sector, there is also a positive effect of ***broadband penetration***, ranging from 0.14 percent on productivity to 0.63 percent on employment for every 1 percent increase in the rate of penetration. It is worth noting, however, that the effects of broadband penetration are not linear but tend to increase with the increases in the rate of adoption (penetration), with effects being particularly strong once the critical threshold is reached. While enabling direct beneficiaries to optimally utilize their capabilities, technologies as broadband also generate spillover effects to related business entities within and across sectors, thus magnifying the effects on economic outcomes (Majumdar et al., 2009). In this context, our findings highlight the need for removal of both supply and demand gaps in broadband penetration.

A somewhat surprising estimation result is the fact that higher ***monthly costs of broadband*** packages are associated with increased employment in both sectors. A likely explanation is that such costs are associated with improvements in the quality of network that enable implementation of applications, services and internet content pivotal for competitive advantage. Hence, quality increases might have over-compensated price increases, and net prices have in fact declined.

3.2.2. Digital transformation and technological intensity

In less sophisticated manufacturing and services industries, digital infrastructure provides primarily benefits through continuous interaction between suppliers and customers. In such interactions, unlimited data use is of more importance than speed. However, in technology- and knowledge - intensive services, where speed of interaction with rivals and rapid exchange of information are competitive advantages, increases in broadband speed have a decisive role. To examine how digital technologies influence firms in sectors of different technological and knowledge intensity, this section introduces interactions between broadband speeds and allowance on the one hand, and technology and knowledge intensity on the other.

Our results show that access to ***broadband speeds*** above 10 mbit/s correspond to 77 percent higher productivity in high-tech sectors when compared to Western Balkan firms in lower technological intensity sectors and with lower internet speeds (Table 6).[33] In the service sector, knowledge-intensive firms with faster broadband speeds have about 40 percent higher productivity than firms in less knowledge-intensive sectors and with lower internet speeds. Positive effects on employment are also more pronounced with an increase in technology and knowledge intensity.

Table 6. Digital transformation and technology intensity – impact differences, in %[34]

Sector	High- vs. low-tech manufacturing		Knowledge- vs. less knowledge-intensive services	
Independent/Dependent variables	Productivity	Employment	Productivity	Employment
Broadband speed (> 10 mbit/s)	+77%	+24%	+40%	+31%
User allowance	+62%	+65%	+19%	+1%

Notes: Between-effect panel data estimator that places emphasis on cross-sectional variation between units (firms, industries, economies) is used; controls for country effects, cross-sectional (annual) shocks that may affect all units and differences in technological intensity are applied; broadband speed is measured with a categorical variable that takes the value of 1 for a user with access to at least 10 mbit/s broadband speed and 0 otherwise; user allowance is measured with a categorical variable that takes value of 1 if unlimited traffic allowance is provided, 0 otherwise.
Source: Authors' calculations.

Technology- and knowledge-intensive firms with ***flat internet use*** reveal a higher productivity of roughly 62 percent and 19 percent, respectively. These findings indicate that digital infrastructure deployment produces stronger productivity effects on high-knowledge and technology-intensive activities than on standardized activities associated with less sophisticated industries. As such, an investment in digital infrastructure can be regarded as a driving wheel of restructuring in these economies. Similar finding holds for the effects on employment, but the magnitude of effects is somewhat smaller.

3.2.3. Geographical effects of digital transformation

Digital infrastructure appears to matter more for firms in rural areas of the Western Balkans than their counterparts in urban areas (Table 7). If equal access to ***broadband speeds*** is provided, it follows that firms in urban areas exert lower productivity and employment gains from increased connectivity than their counterparts in rural areas from both sectors, which is consistent with previous research (Kim & Orazem, 2012; Mack, 2014a). Considering the economic underdevelopment of rural regions and the large gap between urban centers and rural communities in the Western Balkans, far exceeding broader

[33] The addition of interaction terms in log-linear specifications somewhat complicates the interpretation of effects. The overall effect of variables of interest can be obtained as exponential value of their sum. For example, the effect of broadband speeds on firms in high technology intensive sectors compared to firms in low technology intensive sectors and with lower internet speeds is obtained as the exponential value of the sum of coefficients on broadband speed variable, high technological intensity variable, and the interaction between the two.
[34] Table 4c in the Appendix C provides full estimation results.

European trends, rolling out digital infrastructure widely is likely to disproportional effects in rural and more remote communities, otherwise effected by emigration and economic and social decline.

Similar findings hold true when one observes the impact of ***unlimited data use***. Access to broadband (both in terms of speed and use) therefore reduces search, transaction and information costs for firms in remote areas. It also enables remote working schemes and provides firms with access to skilled labor. Finally, it also facilitates access to a larger number of consumers, thus increasing sales prospects. This finding is particularly important, keeping in mind that greater investments in broadband infrastructure are needed in order to provide the white areas of the Western Balkans with adequate broadband service.

Table 7. Digital infrastructure and firm location – impact differences, key findings[35]

Sector	Urban vs. rural Manufacturing		Urban vs. rural Services	
Independent/Dependent variables	Productivity	Employment	Productivity	Employment
Broadband speed (>10 mbit/s)	-7.7%	-2.0%	-3.0%	-5.8%
User allowance	-5.8%	-3.0%	-9.9%	-2.0%

Notes: Between-effect panel data estimator that places emphasis on cross-sectional variation between units (firms, industries, economies) is used; controls for country effects, cross-sectional (annual) shocks that may affect all units and differences in technological intensity are applied; broadband speed is measured with a categorical variable that takes the value of 1 for a user with access to at least 10 mbit/s broadband speed and 0 otherwise; user allowance is measured with a categorical variable that takes the value of 1 if unlimited traffic allowance is provided, 0 otherwise.
Source: Authors' calculations.

[35] Table 5c in the Appendix C provides full estimation results.

3.3. Multiplicative effects of investment in broadband infrastructure

Western Balkan economies significantly lag behind in economic development in comparison to the other post-communist economies that joined the EU in 2004 and 2007.[36] In response, governments should try to develop an institutional framework and a policy mix, which could ensure speeding up of the income convergence towards the EU. One channel through which income convergence could be boosted is the digital transformation, which, as evidenced in section 3.1., could act as a key driver of GDP growth. This section estimates short-term demand effects of investments in broadband infrastructure on the overall value chain of producers delivering equipment to the broadband investor.

Broadband investments positively contribute to the domestic economies in the Western Balkans by increasing the demand for goods and services incorporated in the broadband infrastructure. Total multiplicative effects, which include *direct*, *indirect* and *induced* effects, are estimated by an input-output model.[37] *Direct effects* are related to increases in revenues and employment of those companies that directly supply the telecommunications industry: 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 in order to deploy a broadband infrastructure.[38] 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 and their suppliers. The respective effects on revenues and employment are labeled *indirect effects.* Increase in revenues along the value chain of broadband infrastructure induces a demand for new jobs and leads to an increase of wages and salaries. A proportion of the increased income will be re-spent on final goods and services by households. Increased activity in companies which produce personal goods and services, including activity of their suppliers, is classified as *induced effects*.

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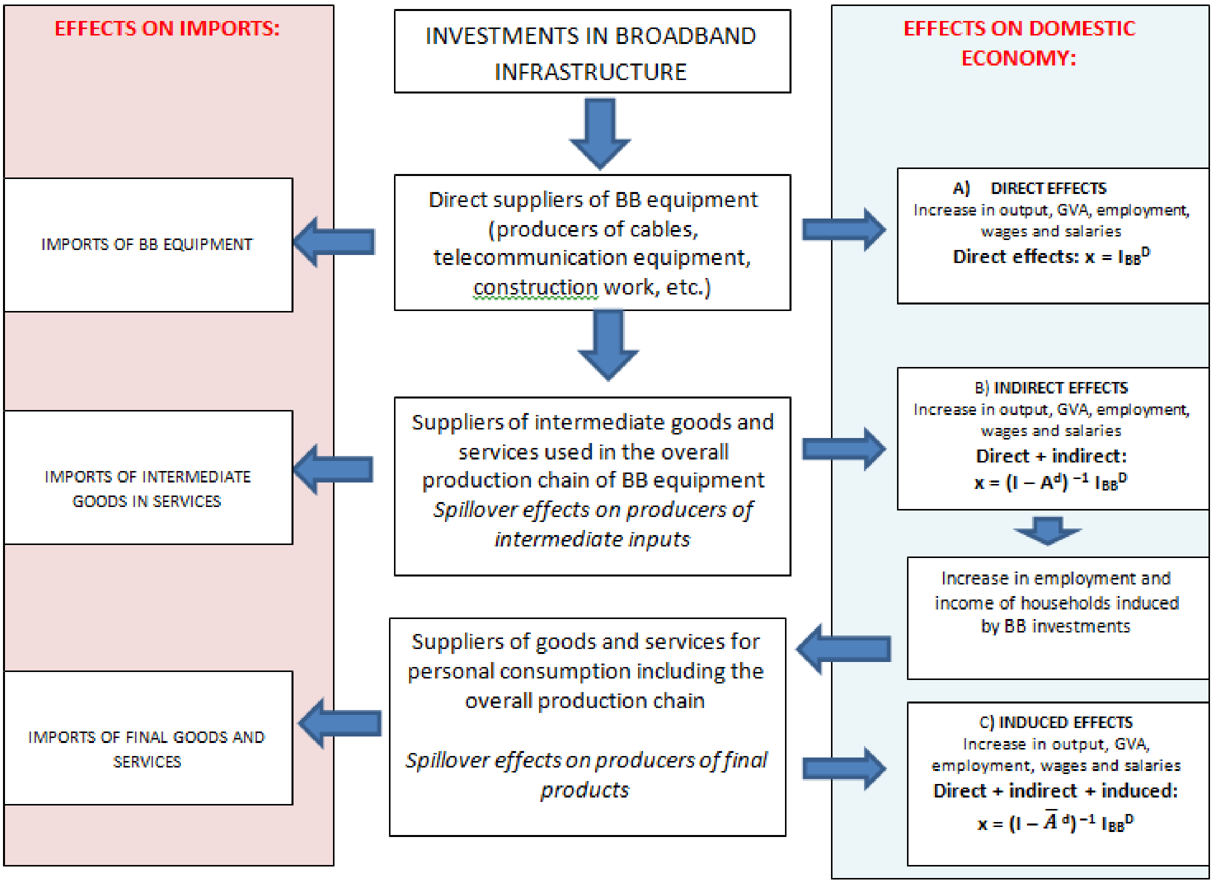
[36] GDP per capita at PPP in 2016 in Western Balkan economies varied from 27 percent of EU-28 average in Kosovo* to 83 percent in Slovenia.

[37] Technical definitions of concepts, technological coefficients and formulas incorporated in I–O analysis are presented in the Appendix D.

[38] For example, 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.

Figure 6. Spillover of direct, indirect, and induced effects of broadband investments



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

The intensity of spillover effects could be estimated by the *simple multiplier or multiplier type I* (Miller & Blair, 2009) defined as the sum of direct and indirect effects (A + B in Figure 6) divided by direct effects (A in Figure 6). *Total multiplier or multiplier type II*, beside the direct and indirect effects, includes effects of induced personal consumption (marked as C in Figure 6) and is defined as a ratio of total effects (A + B + C) to direct effects.[39] Total effects are estimated by the application of the standard I–O model in which broadband investments delivered by domestic companies (I_{BB}^{D} in Figure 6) are treated as an increase in final demand.

3.3.1. The main characteristics of future broadband investments in Western Balkan economies

The value of broadband investment for each Western Balkan economy in the medium-term future will depend on the current condition of broadband infrastructure, geographical and geological factors, population density, distribution of households in urban and rural areas and economic factors such as

[39] Total effects could be estimated via the I–O model with endogenous personal consumption (see Appendix D for technical details).

prices of equipment and the affordability of broadband services.[40] A different technology mix in future Western Balkan investments will affect the value chain of domestic producers and the pattern of diffusion of direct, indirect, and induced effects to production sectors. For instance, while investments in fiber to the cabinet (FTTC) or fiber to the premises/home/buildings (FTTP/FTTH/FTTB) most positively influence the production of cables and construction services, wireless broadband will contribute more to the production or imports of sophisticated transmission devices.

Estimated costs and structure of broadband investments are based on a survey completed by at least one telecommunications company for each Western Balkan economy except Kosovo*. Companies were asked to estimate investment value per new final user for a typical project in a Western Balkan economy they operate (the questionnaire is presented in the Appendix D) and to distribute these costs to the major investment items. A typical project is defined to be large enough (more than 10,000 potential users) and it represents a typical investment in local market regarding the structure of users (urban/rural) and prevailing status of current telecommunications infrastructure. Additionally, survey asked for the distribution of domestic and import contents for individual components of broadband investment.[41]

Based on the results for six Western Balkan economies, we found that the costs of broadband deployment in most of them are on average lower than in developed economies (see Table 1d in Appendix D).[42] Costs of investments based on wireline technology are generally higher than costs of mobile broadband infrastructure.

3.3.2. Multiplicative effects of investment in broadband infrastructure

Multiplicative effects of broadband investments are estimated by an input-output model. Input-output tables are available for four Wester Balkan economies: Albania, Croatia, The Former Yugoslav Republic

[40] Katz, Vaterlaus, Zehnhäusern, Suter, and Mahler (2009).

[41] Some companies pointed out the problem of selection of a representative project. Private telecommunications companies are concerned about project profitability and primarily invest in projects which ensure a return in a shorter period. Majority of private investments are oriented toward urban areas with high population density, which ensure lower costs per user. Actual costs per final user in future period 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 incurred in a typical project of a private investor. Financial viability of investments in those areas could be ensured only if supported by government funds.

[42] 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. The average costs per final user are not fully comparable, but the survey provided a detailed structure of investments as costs are separated to computer and electronic equipment, cables, construction costs and related services.

of Macedonia, and Slovenia, while the average multipliers (in combination with economy-specific data on productivity and price differentials) were used for other economies.

Survey data, similarly to the findings of the previous studies for developed economies, identify the following sectors (according to the standard CPA classification[43]) as the main suppliers of equipment and services incorporated in broadband infrastructure:

- CPA_C26: Computer, electronic, and optical products (including transmission network equipment),
- CPA_C27: Electrical equipment (including fiber optic cables),
- CPA_F: Constructions and construction works,
- CPA_J61: Telecommunications services (including implementation costs borne by the investor).

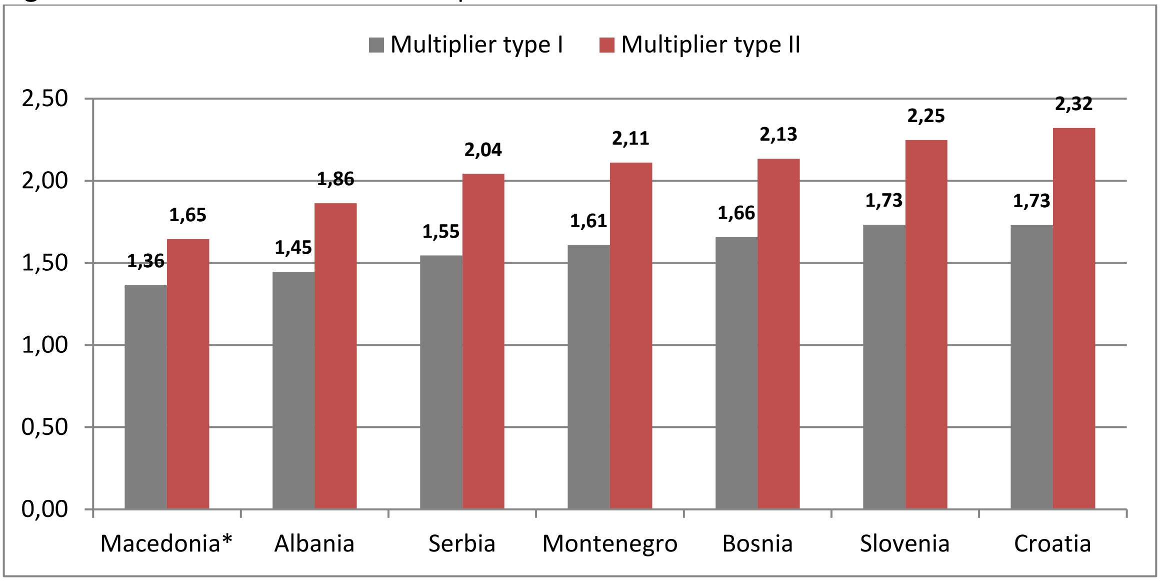
Those sectors are expected to be active as main suppliers in broadband network development[44]. Aggregate output multipliers for total broadband investments discussed in the continuation combine individual sectoral effects in the way that sectoral effects are weighted according to the estimated share of each sector in total investment costs. Output multipliers present the ratios of total output created in an economy to the value of broadband project which is delivered by direct suppliers to investors. A higher multiplier is generally indicative of intensive integration and cooperation between domestic producers, while lower multiplicative effects could stem from 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 7). This means that each euro received by a domestic direct supplier of broadband infrastructure indirectly induces additional output of other domestic producers included in the value chain, estimated in range between 36 cents in The Former Yugoslav Republic of Macedonia to 73 cents in Croatia and Slovenia. Type I multiplier is the lowest for The Former Yugoslav Republic of Macedonia and Albania because of high import dependency, especially regarding components incorporated in mobile network. A more favorable technological structure and existence of domestic suppliers capable to deliver sophisticated equipment resulted in the highest multipliers estimated for Croatia and Slovenia. If the effects of induced personal consumption (multiplier type II) are included, total output induced by broadband investment is expected to be 1.65 (The

[43] 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).
[44] Individual sectoral multipliers for output, gross value added and employment for the most important broadband infrastructure developers are presented in Appendix D. In the terms of national accounts, gross value added is equal to the difference between revenues (value of output) and intermediate consumption.

Former Yugoslav Republic of Macedonia) to 2.32 (Croatia) times higher than the initial value of broadband investment delivered by a domestic producer.

Figure 7. Broadband investment multipliers



Note: *The Former Yugoslav Republic of Macedonia
Source: Authors' calculations.

In order to compare multiplicative effects estimated for individual Western Balkan economies, the investment structure derived from the survey is scaled up to a common nominator: hypothetical value of 100 million euro invested in each of Western Balkan economy. As multipliers are active only for part of investments delivered by a domestic company, total effects depend also on the share of investment contracted to foreign companies. According to the survey data, investments are directly supplied by domestic firms in Croatia, Albania, and Serbia. In other Western Balkan economies, a certain proportion of equipment is usually supplied by foreign companies which reduce the potential for spillover effects to other domestic companies. Figures 8 to 10 and Table 2d in Appendix D summarize the effects of 100 million euro assumed to be invested in broadband infrastructure in each individual Western Balkan economy.

The total gross value added induced by comparable value of broadband investments is estimated to be the highest in Croatia, Serbia, Albania, and Slovenia (Figure 8). In Croatia and Slovenia, it is a result of 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 value added 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 the case of The Former Yugoslav Republic of Macedonia, both 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 to spread out widely over domestic producers in Montenegro, Bosnia and Herzegovina, and The Former Yugoslav Republic of Macedonia, where total GVA induced is estimated to only 40–60 percent of initial investment value.

Broadband investments could potentially contribute to the dynamics of new job openings in Western Balkan economies. It is estimated that broadband investments of 100 million euro could induce new jobs in a range from 3,000 to 10,000. As a result of lower labor productivity (more labor is required per unit of output), 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 The Former Yugoslav Republic of Macedonia.

Investments of 100 million euro could provide a strong stimulus to the region characterized by stagnant or mediocre economic growth. Depending on the size of the economy and productivity, a demand stimulus through 100 million euro broadband investments would induce additional GVA in 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 The Former Yugoslav Republic of Macedonia, to 0.9 percent in Albania, and 2.1 percent in Montenegro (Figure 10). Broadband investments will improve the overall productivity as the relative effects on GVA exceed the effects on employment. By adding new economic benefits and job vacancies, broadband investments not only induce economic benefits, but also promote greater political stability, higher quality of public services. As discussed in chapter 4, a wider reach of broadband access can reap substantial political and social benefits, as it enables the provision of e-governance and social inclusion.

The share of imports in total value of broadband investment is significant in most of Western Balkan economies. Even if the investment is contracted directly to domestic producers, a certain proportion of sophisticated equipment would need to 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 it 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 The Former Yugoslav Republic of Macedonia, reaching more than 50 percent of initial investment value. In comparison to more developed economies, multiplicative effects in the Western Balkans are substantially lower[45] due to less developed and integrated domestic high-tech sectors and high-import content. However, a stable demand for broadband equipment expected in the foreseeable future is definitively an opportunity for Western Balkan economies

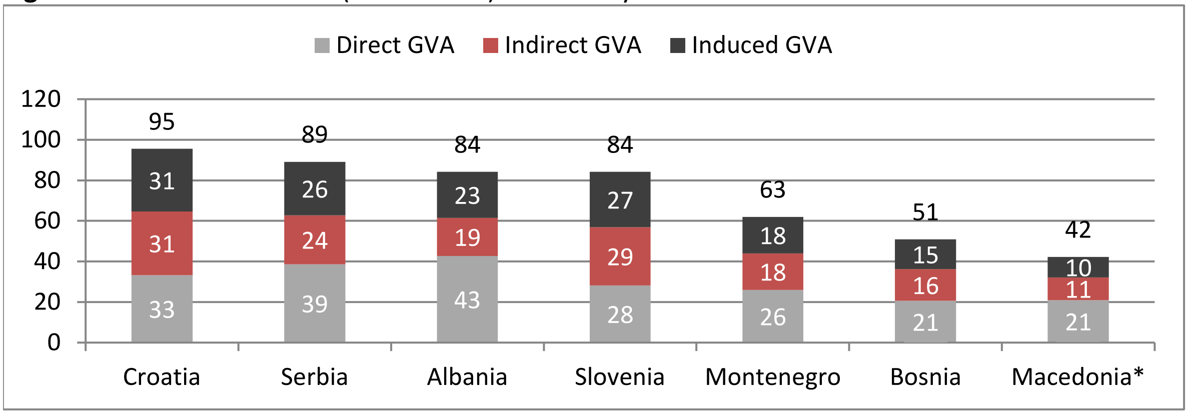
[45] In studies covering the USA, Canada and Germany multipliers are estimated to more than 3 (Katz et al., 2009).

to improve institutional framework in order to attract FDI and speed up the process of 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 estimated by the application of input-output model based on current technological coefficients.

The deployment of broadband infrastructure in areas where relative costs per user are high could be assessed 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. Based on current tax burdens[46] in Western Balkan economies, an investment of 100 million euro could induce between 15 (The Former Yugoslav Republic of Macedonia) to 47 (Serbia and Croatia) million euro of additional government revenues. Thus, the cost of these investments is significantly off-set by the potential benefits. Estimates of total value of broadband investments required to reach strategic goals are generally not available for Western Balkan economies, except for Croatia. Box A estimates the total effects of broadband investments required to reach Croatian broadband strategic goals and could serve as a plausibility check for the estimated results in this report.

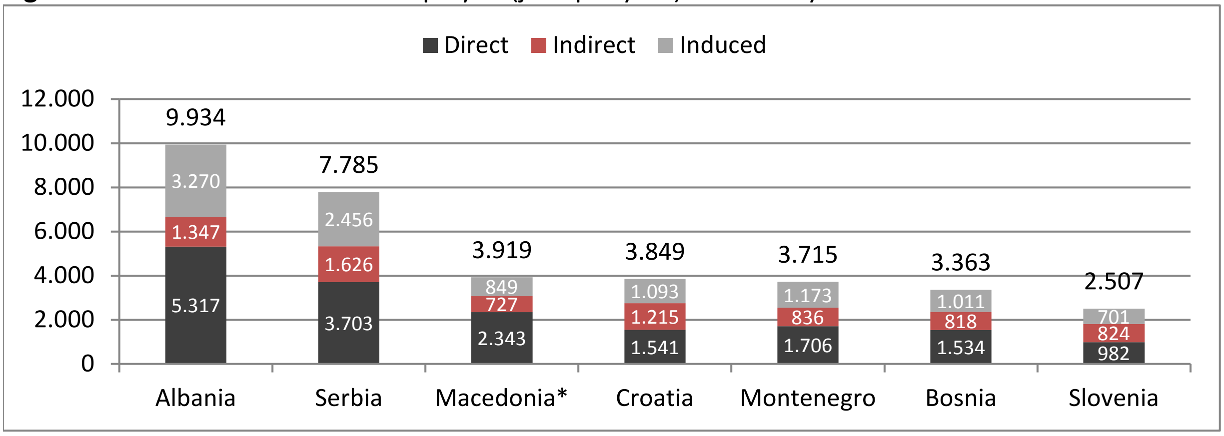
[46] Ratio of total government revenues to GVA (including taxes, social contributions, and non-tax revenues).

Figure 8. Gross value added (in Mil. euro) induced by BB investment of 100 Mil. euro



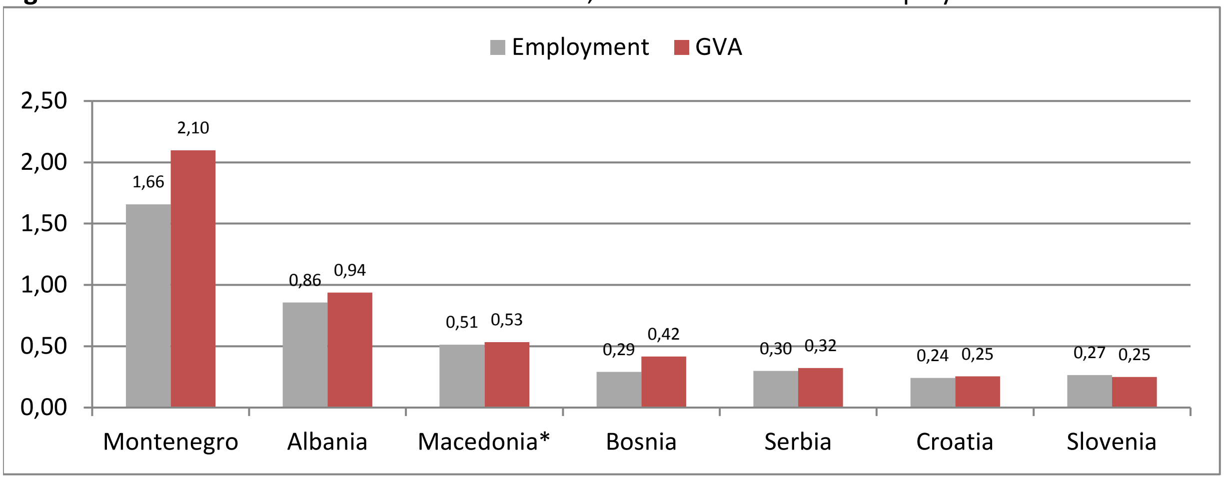
Note: *The Former Yugoslav Republic of Macedonia

Figure 9. Number of individuals employed (jobs per year) induced by 100 Mil. euro BB investment



Note: *The Former Yugoslav Republic of Macedonia

Figure 10. Effects of 100 Mil. euro BB investment, as % of total GVA and employment



Note: *The Former Yugoslav Republic of Macedonia

Generally, mobile network projects with a dominant share of imported electronic equipment imply lower multiplicative effects. Broadband networks based on fiber require comprehensive construction works and thus could induce higher multiplicative effects. The deployment of broadband infrastructure in areas where relative costs per user are high could be assessed 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. Based on current tax burden[47] in Western Balkan economies, an investment of 100 million euro could induce from 15 (The Former Yugoslav Republic of Macedonia) to 47 million euro of additional government revenues in Serbia and Croatia. Estimates of total value of broadband investments required to reach strategic goals are generally not available for Western Balkan economies, except for Croatia.[48]

3.3.3. Multiplicative effects related to future broadband operation

The effects presented previously relate to one-off short-term economic impact of demand stimulus, active only in the period of broadband infrastructure deployment. However, the positive economic impact of available broadband internet is not fully exhausted once infrastructure is developed. Broadband operators could increase the number of users and revenues, value added, and potentially the employment through broadband investments. As broadband output increases, 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 which participate in the value-added chain depend on the level of integration of domestic producers.

The impact of broadband services on all domestic producers which use it as an intermediate input could be described by forward linkages (increased availability of broadband services improves productivity of other domestic sectors which use broadband services as an intermediate input). Both backward and forward effects are spreading out to other industries through inter-sectoral connections.

Backward multipliers (type II) for the telecommunications sector in individual economies based on officially available input-output range from 1.7 in The Former Yugoslav Republic of Macedonia to 2.1 in Croatia (see Appendix D). It means that if output of the telecommunications sector (because of new users connected to broadband infrastructure) increases for 1 unit, the total output in domestic economy would increase from 1.7 to 2.1 units. However, future intensity of backward linkages depends on many factors and could be changed when sizeable reconstruction projects are finished.

[47] Ratio of total government revenues to GVA (including taxes, social contributions, and non-tax revenues).
[48] To illustrate the economic benefits of larger scale investments needed to reach national conectivity goals, in Appendix D we present the estimates of economic benefits of total broadband investment required to reach national strategic goals in Croatia.

Future forward effects are even more unpredictable. According to the existing studies (Heng, 2014; Davies, 2015), 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. 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 require fast, reliable and wide-spread availability of the broadband. These are essential moving the region forward in terms of rule of law and reducing corruption as section 4 will explore in greater detail.[49]

[49] In Appendix D we used the same methodology to estimate economic benefits of total broadband investment required to reach national strategic goals.

3.4. Cross-border effects of digital transformation

In addition to the macroeconomic, sectoral, and microeconomic effects of the digitalization process, faster and more harmonized digitalization process in Western Balkan economies may also boost regional economic cooperation. The impact on regional cooperation can be assessed by using two indicators: the index of economic cooperation among Western Balkan economies, and the indicator of digital transformation convergence. These two indicators enable us to formalize and explain the relationship between economic cooperation and harmonization of digital transformation in the Western Balkans.

Besides the impact on economic cooperation, increased digital transformation across the Western Balkan region could also improve the region's investment attractiveness and increase funding from the EU's private sector as well as from the international financial institutions. For that reason, it is necessary to make an effort to increase harmonization and standardization of digital transformation across all Western Balkan economies.

3.4.1. Economic cooperation of Western Balkan economies

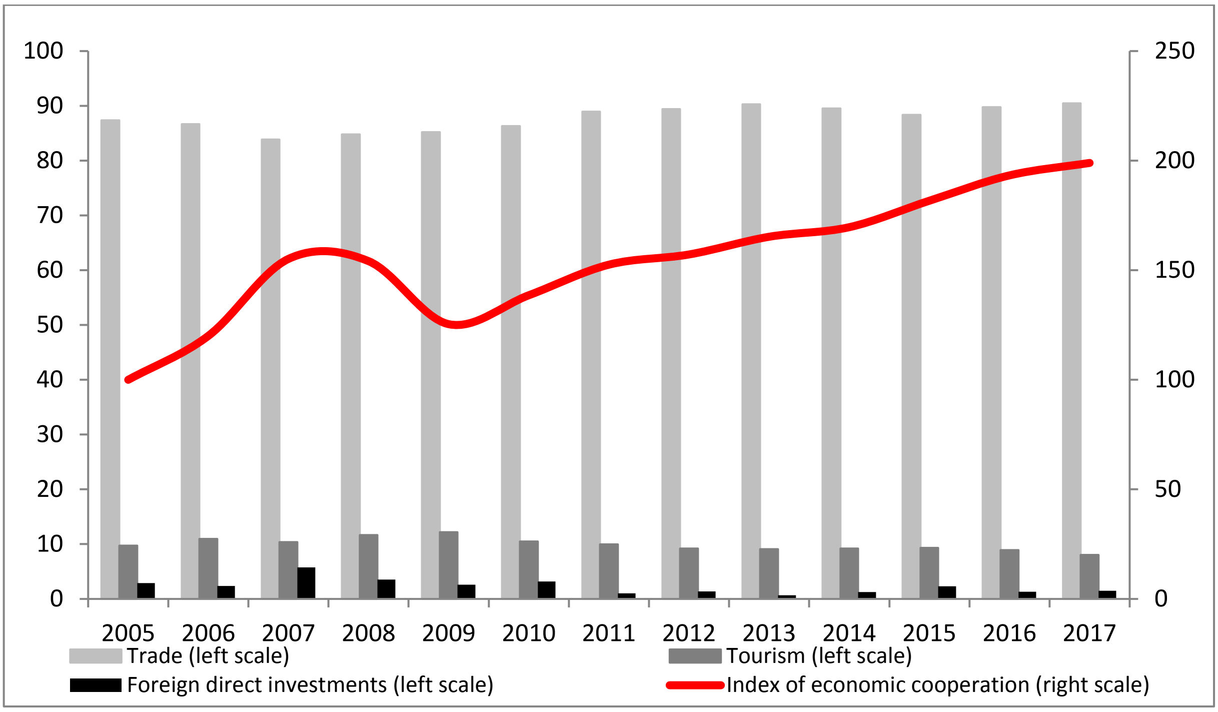
Although the dramatic breakup of Yugoslavia ruptured the economic cooperation among the economies in the region, their cooperation began to intensify again after 2000. Slovenia and Croatia have in the meantime joined the EU and have gained access to a market of more than 500 million inhabitants. At the same time, economic cooperation between these two economies and the rest of the region continues to expand. In addition to strong trade links among Western Balkan economies, their relative geographical proximity, language similarity, existing relationships and common history also facilitate increasing regional direct investments and an interchange of tourists. In order to quantify the level of economic cooperation in the region, we use data on bilateral merchandise trade flows, foreign direct investments and tourist arrivals among Western Balkan economies (Albania, Bosnia and Herzegovina, Croatia, The Former Yugoslav Republic of Macedonia, Kosovo*, Montenegro, Serbia, and Slovenia) as a basis for the calculation of the index of economic cooperation for the period between 2005–2017 (Figure 11).[50]

The values of the index suggest an uneven, but rising trend of economic cooperation among Western Balkan economies. The increasing cooperation in the first few years was brought to a halt by the global economic downturn in 2008. After a reduction in 2009, the economic cooperation exhibited a modest recovery in 2010. The gradual growth of cooperation continued until 2016. An index estimate for 2017 suggests that the positive trend has continued.

[50] Detailed description of the methodology can be found in the Appendix E.

The contribution of foreign trade, direct investments, and tourism to overall economic cooperation in the region can be assessed using the relative weights of these three activities in the index (Figure 11). The cooperation among these economies is dominated by foreign trade, with its share in overall cooperation reaching 89.8 percent in 2016. Compared to trade, cooperation through tourism and direct investments in the region is relatively weak, with their share in economic cooperation amounting to 8.9 and 1.3 percent, respectively. The modest shares of tourism and foreign direct investments in overall economic cooperation reveal currently untapped potential for further development, which could be further enhanced by a more harmonized approach to digital transformation of these economies.[51]

Figure 11. Index of economic cooperation for the economies in the region, with contributions of individual economic sectors to the index



Notes: Index of economic cooperation – 2005 = 100; shares in total cooperation – in %.
Source: Authors' calculations.

On the level of an economy, the largest contribution to economic cooperation among Western Balkan economies comes from Slovenia (29.6 percent) and Croatia (26.1 percent). They are followed by Serbia (18.6 percent), and Bosnia and Herzegovina (14.5 percent). Albania, Montenegro, Kosovo* and The Former Yugoslav Republic of Macedonia have a relatively small contribution to the overall index of

[51] One has to note that merchandise trade, direct investments, and tourism are not the only ways in which Western Balkan economies cooperate among themselves. However, these three cooperation facets are the only ones for which one can obtain data. As the bilateral data on trade of services, work related migrations, portfolio capital, and factor income flows are not available, we could not include them in the calculation of the index. However, it would be reasonable to expect that they too follow the same general trend outlined by the index of economic cooperation.

economic cooperation, mainly due to the smaller size of these economies. Thus, joint share of these economies in the overall index of cooperation is 11.2 percent.

3.4.2. Digital convergence of Western Balkan economies

In order to measure the convergence of Western Balkan economies in digital transformation, we calculated the coefficient of variation for various indicators of digital transformation using data for individual economies for the period from 2005 to 2016.[52] Coefficient of variation measures to what extent individual economies differ in digital transformation indicators from the regional average.[53] Coefficients of variation for the analyzed group of Western Balkan economies are calculated for the following individual indicators: fixed-telephone subscriptions per 100 inhabitants, internet users (percentage), percentage of the population covered by a mobile-cellular network, mobile-cellular subscriptions per 100 inhabitants, fixed broadband subscriptions per 100 inhabitants, international internet bandwidth per internet user, estimated proportion of households with a computer, estimated proportion of households with internet access at home (Figure 13 and Figure 1e in the Appendix E). We then use these individual values of coefficients of variation for different indicators to obtain the overall measure of digital transformation convergence for Western Balkan economies (Figure 13).

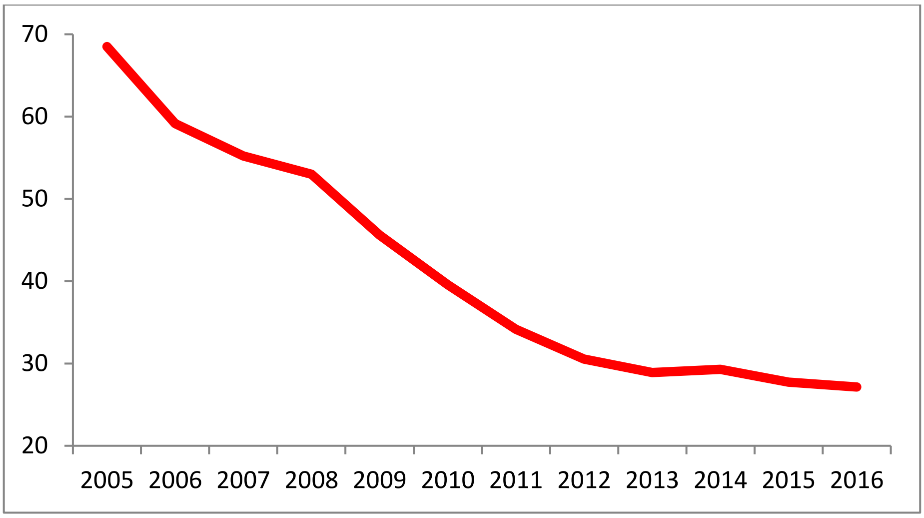
The decreasing values of the overall digital transformation convergence over time indicate that Western Balkan economies have indeed experienced increased digital transformation convergence. We assume this outcome is mainly the result of the overall technological progress in these economies, as there were no formal initiatives aimed at promoting a harmonized and standardized approach to digital transformation. Thus, as individual technologies are being deployed and used, economies exhibit more convergence both in individual value of coefficients of variation, and in the overall measure of digital transformation convergence. This convergence would have been even more pronounced had the individual Western Balkan economies been implementing common policies emphasizing a harmonized and standardized approach to digital transformation. Hence, we can conclude that digital transformation convergence that has already been taking place in effect necessitates a more harmonized cross-country approach. This conclusion is further supported by the fact that economic cooperation among the economies in the region became more intense as digital transformation convergence progressed over

[52] Detailed description of the methodology can be found in the Appendix E.

[53] The decrease of the coefficient of variation through time implies that the variability between the economies in the region is reduced and hence the degree of digital convergence between them has increased. In other words, as the coefficient of variation enables us to track to what extent individual economies diverge in percentage terms from the average regional value of a certain digital transformation indicator, the lower value of the indicator thus suggests a more intense digitalization convergence in the region. Thus, in an extreme case, if the value of a coefficient of variation for the share of internet users in the population in a given year is 0, this would suggest that all Western Balkan economies have the same share of internet users in that year.

time. Namely, by comparing Figures 11 and 12 we can state that digital transformation convergence is positively correlated with economic cooperation. Thus, placing more emphasis on a harmonized and standardized cross-country approach to digital transformation could potentially boost economic cooperation in the future. The benefits of a collaborative approach to digital transformation of the region would thereby not be limited just to the increased economic cooperation, but they would also materialize in terms of an increased economic growth of individual Western Balkan economies and more stable economic and political situation in the region. Digital regional integration could thus both dovetail other aspects of regional integration, as well as take advantage of regional linkages to create business clusters.

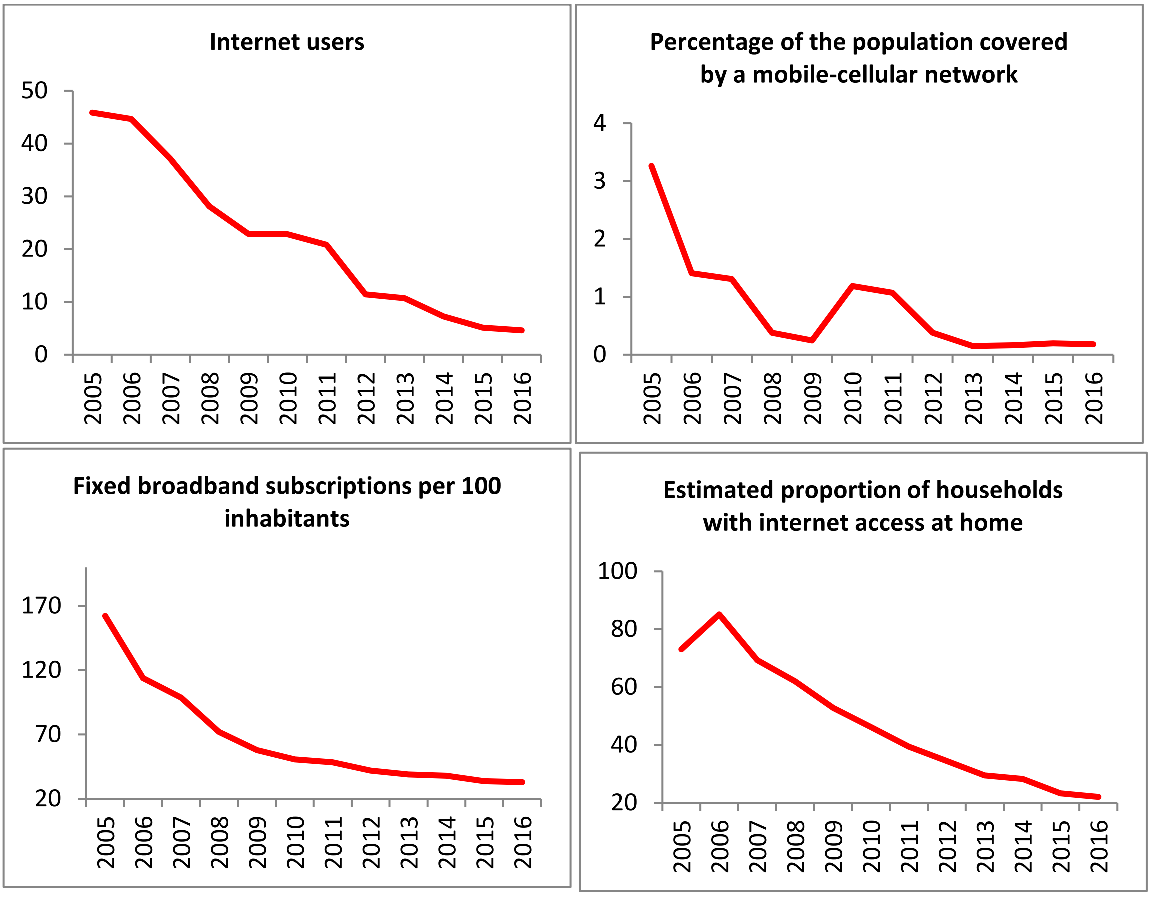
Figure 12. Digital transformation convergence in Western Balkan, measured by the coefficient of variation



Notes: Scale is in %; 0 indicates complete convergence; the larger the coefficient of variation, the larger the divergence between Western Balkan economies in a given year.
Source: Authors' calculations.

The intensity of the digital transformation convergence is different for each digital transformation indicator (Figure 13 and Figure 1e in the Appendix E). The convergence is particularly pronounced in the proportion of households with internet access at home, the share of internet users, fixed broadband subscriptions per 100 inhabitants and the percentage of the population covered by a mobile-cellular network. The convergence process has been especially intense in fixed broadband subscriptions per 100 inhabitants. In this area, initial average deviation of individual economies from the regional average of fixed broadband subscriptions per 100 inhabitants amounted to more than 160 percent of the average. As fixed broadband subscriptions in all Western Balkan economies increased substantially over the observed period, by 2016 this deviation decreased to just about 30 percent of the regional average. Convergence among Western Balkan economies is almost complete in the percentage of population covered by a mobile-cellular network, which means that the coverage of mobile-cellular network is very similar in the region, regardless of the economies' individual level of development. Although with somewhat lower intensity, other indicators also confirm the convergence process.

Figure 13. Digital transformation convergence – individual indicators, measured by the coefficient of variation



Notes: Scale is in %; 0 indicates complete convergence; the larger the coefficient of variation, the larger the divergence between Western Balkan economies in a given year.
Source: Authors' calculations.

3.5. Labor market effects of digital transformation

Digital transformation is, in general, believed to have two opposing effects on the labor market (see, for example, Degryse, 2016 or De Groen, Lenaerts, Bosc, & Paquier, 2017). On the one hand, digital transformation might increase labor productivity, make work arrangements more flexible, increase the quality of the working life, and increase employment by creating new jobs. However, technological advances, including digital transformation, might induce the substitution of human work (especially low-skilled labor) with technology and thus reduce employment. As examined bellow, available empirical evidence suggests that the job creation effect dominates the the substitution effect, so that the overall net effect on employment is positive.

Although the empirical evidence on the impact digital transformation has on the labor market remains scarce (mainly due to data unavailability), and despite the fact that many concerns in the area of employment and social security are raised, job losses due to digital transformations are not very likely (Eichhorst, Hinte, Rinne, & Tobsch, 2016; Walwei, 2016). However, the existing literature suggests that digital transformation is going to change and is already changing the main features of the labor markets. Computerization and automation are likely to change the structure of employment by changing entire industries, occupations, necessary skills, and required tasks (Walwei, 2016). That implies that new jobs will be created, while some of the existing will have to be transformed or will simply become redundant. De Groen et al. (2017) argue that digital transformation will partly require new skills to perform the newly created jobs, which means that either the current workers will have to requalify, or they will be replaced by those workers who already have the appropriate skills. This would suggest that digital transformation might intensify labor market polarization, which has already been observed due to globalization, and, in particular, after the recent recession (e.g., Jaimovich & Siu, 2012).

Yet, digital transformation is also changing work opportunities for many workers who did not have access to labor market previously (Evangelista, Guerrieri, & Meliciani, 2014; World Bank, 2016) and is thereby expanding the labor market. The report by the World Bank (2016) says that because of the reduction of the transaction costs due to internet, people who usually face barriers in finding jobs have easier access to the labor market, which means that digital transformation essentially promotes labor market inclusion for women, persons with disabilities and for those in distant areas (World Bank, 2016). For example, the report explains how new technologies allow women to participate more easily in the labor market - through e-commerce, in online work, or in business-process outsourcing - demonstrating that digital transformation can become a solution to one of the biggest problems on the labor markets in the developing economies, i.e., low female labor force participation (World Bank, 2016). Given the rather low female participation in Western Balkan economies (51 percent on average for the working-age population [15–64] in 2016[54]) the results of the named study indicate that accelerated digitalization can help women get more involved and active in the labor market. Considering the low female participation in the work force in the region, increased participation in the digital sector and related fields would not just carry economic benefits, but also contribute to rectifying social imbalances that have emerged over the past decades as women have found it harder to participate in the formal economy.

Furthermore, the report shows how entrepreneurship and self-employment are also bound to substantially increase in the digital economy. All this would suggest that digital transformation increases employment and labor productivity. Besides the replacement of the existing jobs with new ones, digital transformation, together with globalization, brings completely new forms of employment and organization of work to the labor market. Wide variety of flexible and non-standard forms of work are already replacing standard employment contracts, while terms such as crowd working, offshoring, on-demand economy, sharing economy, platform economy, or gig-economy are becoming typical concepts when discussing modern labor markets (e.g., Eichhorst et al., 2016 or Glauman & Gjelstrup Björdal, 2017)[55].

Even though studies on the effects of digital transformation on employment are scarce, research on the effects of high-speed broadband specifically on labor market outcomes are even rarer.[56] However, there are some studies that (empirically) estimate the effects of broadband on the labor market outcomes, especially for developed economies.

For instance, an earlier study by Lehr, Osorio, Gillett, and Sirbu (2006) empirically established that broadband in the US in the period 1998–2002 positively affected economic activity, more specifically employment, the number of overall businesses, as well as the number of businesses in IT-intensive sectors. Crandall, Lehr, and Litan (2007), using the US data on the state level, have estimated the effects of broadband penetration on both output and employment and showed that for every percentage point increase in broadband penetration, employment is projected to increase by 0.2 to 0.3 percent per year (an increase of about 300,000 jobs at the US level). Existing studies of the effect of digital transformation on employment thus indicate that digital transformation spurs employment in the developed economies.

[54] From 19 percent in Kosovo* to 69 percent in Slovenia. Source: International Labour Organization (ILO), ILOSTAT database.

[55] For more details, see Agrawal, Horton, Lacetera, and Lyons (2015); Kenney and Zysman (2016); Velenduc and Vendramin (2016); or Horton, Kerr, and Stanton (2017).

[56] A study by the European Commission that revised over 200 earlier studies (from 2009) states that only 11 percent of them mention high-speed broadband (EC, 2013).

Based on the available evidence, we can infer that investment in digital infrastructure also fosters employment. Atkinson, Castro, and Ezell (2009) analyzed the employment impact of investments in three IT infrastructure projects in the US—broadband networks, health IT, and the smart power grid, and concluded the following: IT infrastructure investment would spur significant job creation in the short run, with investment in broadband networks bringing the largest number of jobs, while investments in digital infrastructure would lead to higher productivity, increased competitiveness, and improved quality of life in the long run. Similarly, Katz, Vaterlaus, Zehnhäusern and Suter (2010) empirically estimated a rather significant (positive) impact of investment in broadband technology on employment in Germany (the "National Broadband Strategy" and the expected evolution of ultra-broadband through 2020): a total investment of close to 36 billion euro would generate a total of 968,000 incremental jobs (more than half would be derived from construction of the network and the rest from the enhanced innovation and new business creation).

Additionally, a recent study by Hjort and Poulsen (2017) provides evidence on how fast the internet affects employment in the developing economies. Precisely, they show that changes in average speeds and use of internet after the arrival of the submarine cables in 12 African countries in the late 2000s and early 2010s increased the employment rate from 4.2 to 10 percent in connected areas at the onset of fast internet availability. This study also established that, although the technology decreases employment for unskilled jobs, it enables a bigger increase in employment in higher-skill occupations.[57] They also argue that fast internet lowers to some extent the employment inequality across educational groups in the observed economies. Thus, they conclude that "building fast Internet infrastructure may be among the currently feasible policy options with the greatest employment-creating potential in Africa" (Hjort & Poulsen, 2017, p. 25).

Considering the labor productivity, Fornefeld, Delaunay, and Elixmann (2008) found that companies adopting broadband-based processes improve their employees' productivity on average by 5 percent in the manufacturing sector and by 10 percent in the services sector, while Qiang, Rossotto, and Kimura (2009) found that people working from home due to the availability of broadband (the case of British Telecommunications in 2004) resulted in an increase in productivity of 20 percent.

Table 8 provides a summary of examined empirical works presented in the text above.

Table 8. Summary of examined empirical studies relating digital transformation and labor market outcomes

[57] Similarly, Falk and Biagi (2017), in seven EU countries during 2001–2010, show that the use of different ICT technologies and digitalization increases the share of highly skilled workers, which is more pronounced in manufacturing than in service industries.

Author(s)	Year	Reference period	Area	Analyzed effect(s)	Labor market outcome(s)
Lehr, Osorio, Gillett, and Sirbu	2006	1998–2002	US	broadband availability	Increase of employment, the number of overall businesses, and the number of businesses in IT-intensive sectors
Crandall, Lehr, and Litan	2007	2003-2005	US	broadband penetration	increase of (nonfarm private) employment
Fornefeld, Delaunay, and Elixmann	2008	2004-2006 (predictions over the period 2006–2015)	Europe	companies adopting broadband-based processes: composite indicators that portrait broadband adoption	improves employees' productivity; more so in the services sector than in the manufacturing sector
Atkinson, Castro, and Ezell	2009	predictions for short- and long-run	US	investments in three IT infrastructure projects: broadband networks, health IT, and the smart power grid	significant job creation in the short run, higher productivity, increased competitiveness, and improved quality of life in the long run
Qiang, Rossotto, and Kimura	2009	2004	UK	people working from home due to the availability of broadband	increase in productivity
Katz, Vaterlaus, Zehnhäusern and Suter	2010	2010-2014 2015-2020	Germany	investment in broadband technology	Increase of employment
Evangelista, Guerrieri, and Meliciani	2014	2004-2008	EU-27	impact of digital technologies (set of composite ICT indicators)	increase of employment and productivity with favouring the inclusion of 'disadvantaged' groups in the labour market
Falk and Biagi	2017	2001–2010	7 EU countries	use of different ICT technologies and digitalization	increases of the share of highly skilled workers; more pronounced in manufacturing than in service industries
Hjort and Poulsen	2017	late 2000s and early 2010s	12 African countries	average speeds and use (availability) of internet	increase of employment rate in conncted areas; bigger increase in employment in higher-skill occupations

Notes: For more extensive overview of the (empirical) literature, please refer to Eichhorst et al. (2016) or Horton et al. (2017).
Source: Authors.

3.5.1. Digital transformation and labor market outcomes in the Western Balkans

A quarter of a century after the beginning of the transition process, the labor markets in Western Balkan economies are still struggling with low activity and employment rates, especially for women. The literature suggests these problems share common structural roots. Gligorov, Landesmann, Stehrer, and Vidovic (2008), for example, name low export capacity, skill mismatches and problems with competition in the product markets, in addition to a high share of the informal sector[58], as well as significant dependence on remittances, as the main factors behind the poor labor market developments. The

[58] Up to 30 percent of employment in some of these economies (OECD, 2016).

recent recession only aggravated the existing problems. Kovtun, Cirkel, Murgasova, Smith, and Tambunlertchai (2014) emphasize other structural problems, including delayed transition and a poor investment climate—resulting in low FDI inflows. Hence, to alleviate labor market problems, reforms in these economies should focus on the strengthening of macroeconomic stability and improving the business environment (Kovtun et al., 2014).

It is no surprise then that, with the exception of Croatia and Slovenia, there is little data available on the effect of digital transformation on the labor markets. The European Commission (EC, 2013) estimates that job creation (as a proportion of all jobs created by 2020), due to digital transformation (next-generation access deployment), is about 5 percent in Croatia and about 1.5 percent in Slovenia (EU-27 average being between 0.6 percent and 1.8 percent, depending on the scenario). The results of this study presented in section 3.2. show that the effects of digital transformation on employment in Western Balkan firms, although not big, are clearly positive and mostly focused on the manufacturing sector and on knowledge-and technology-intensive firms.

3.5.2. Digital transformation, educational structure, and skills in the Western Balkans

The provision of broadband services through closer cooperation with the private sector is thus one of the 15 policy dimensions critical for improving the competitiveness of the Western Balkans (without Croatia and Slovenia), mentioned in the "OECD Competitiveness Outlook 2016" (OECD, 2016). The report argues for the development of educational information management systems and the allocation of funds to implement ICT curricula in primary and secondary schools in order to foster e-commerce, economic growth, and regional competitiveness. However, there are some strong differences in both labor market as well as ICT indicators among Western Balkan economies.[59]

The share of employment in ICT (information and communication) sector within the total employment in Slovenia and Croatia is similar to EU-member states (Table 8) such as Austria and Germany, slightly above 3 percent of the total employment.[60] In Bosnia and Herzegovina and the Former Yugoslav Republic of Macedonia, on the other hand, less than 2 percent of workers are employed in the ICT sector. The picture is different in a specific segment of the broader ICT sector, i.e., telecommunications. While only 0.2 percent of the total employment works in the telecommunications sector in Germany, the share is considerably higher in the Western Balkans, namely 1 percent of the total employment in

[59] This should not come as a surprise given the large disparities across EU countries in the various dimensions of digitalization (Evangelista et al., 2014).

[60] World Bank (2016) reports that in OECD countries about 3–5 percent of the total employment is in the ICT sector. The same report emphasizes the indirect job-creation by the technological advances. Namely, it is mentioned that in the US each high-tech job generates 4.9 additional jobs in other sectors.

Croatia, and 0.7 percent in Bosnia and Herzegovina, Serbia, and Slovenia. This might suggest that although the share of employment in ICT sector in most Western Balkan economies is not lagging much behind the developed (EU) economies, it is mostly consumed by the needs of the telecommunications sector, which in turn may exhibit different overall effects on Western Balkan economies when compared to their EU counterparts. However, since more detailed data are not available, one can only speculate on possible effects of these differences in the structure of ICT employment.

Table 9. Structure of employment in the Western Balkans and selected EU economies, in 2016

Economy	**Share of employment in the ICT sector among total employment (%)**	**Share of employment in telecommunications among total employment (%)**	**Employed population (25–54) with advanced education (% of total) [a]**
Albania**	n.a.	0.4	20.1
Bosnia and Herzegovina***	1.8	0.7	19.3
Croatia	3.1	1.0	30.0
Kosovo*	2.1	0.6	24.0
The Former Yugoslav Republic of Macedonia	1.8	0.4	27.8
Montenegro**	2.3	n.a.	30.3
Serbia	2.2	0.7	27.0
Slovenia	3.3	0.7	36.9
Austria	3.1	0.5	36.4
Germany	3.1	0.2	31.2

Notes: [a]Advanced education comprises short-cycle tertiary education, a Bachelor's degree or an equivalent educational level, a Master's degree or an equivalent educational level, or a doctoral degree or an equivalent educational level according to the International Standard Classification of Education 2011; ** 2015, *** 2014 (except for education indicator).
Source: International Labour Organization (ILO), ILOSTAT database.

Besides adapting to new technologies, participants on the labor markets in Western Balkan economies needed to adapt to new ways of doing business, i.e. to the market economy, not so long ago. The privatization and the restructuring of old state or socially-owned firms in the 1990s drastically changed the structure of the labor markets in the region. The need for new skills induced the boom of tertiary education (Tomić & Tyrowicz, 2010), which is also evident in the Table 9. On average, 27 percent of the employed population in these economies has finished some form of tertiary education. However, apart from Slovenia, this is still below the level of more advanced EU member states—Austria (36 percent) and Germany (31 percent), with Bosnia and Herzegovina and Albania at the bottom, with 19 and 20 percent of employed population with advanced education, respectively.

Nevertheless, if we want to assess the skills structure of the existing workforce, i.e. the preparedness of the labor force for the use of new technologies, we would need to look more closely into the educational structure of the workforce in these economies, including their degree of specialization and relevance of the on-the-job training. Data on the quality of education in relevant area (math and science) and the availability of scientists and engineers in a given economy (Table 10) suggest that there is considerable heterogeneity among the analyzed economies.

Table 10. Relevant skills indicators

Economy	Quality of math and science education**		Availability of scientists and engineers***	
	Score	Rank/139	Score	Rank/137
Albania	4.8	28	3.3	113
Bosnia and Herzegovina	3.6	92	3.4	107
Croatia	4.8	31	3.6	95
Kosovo*	n.a.	n.a.	n.a.	n.a.
The Former Yugoslav Republic of Macedonia	4.3	60	n.a.	n.a.
Montenegro	4.6	39	3.7	85
Serbia	4.4	48	3.9	68
Slovenia	5.3	13	3.9	69
Austria	4.6	37	4.5	36
Germany	5.2	16	5.2	11

Note: Scores are measured on a 1-to-7 (best) scale.
Source: ** World Economic Forum (2016); *** Global Competitiveness Report 2017–2018.

For example, Slovenia fares better than both Austria and Germany as far as the quality of math and science education is concerned, while in the case of the availability of scientists and engineers it is in a similar position as Serbia, and lags behind the developed EU economies. Albania, on the other hand, stands rather well when it comes to the quality of math and science education, while in the case of the availability of scientist and engineers it has the lowest ranking (113 out of 137 analyzed economies in total).[61] Unfortunately, the available data do not let us discuss these issues into more depth, as the exact degree of specialization of the workforce, including the one acquired through on-the-job training, is not known for these economies.[62]

3.6. Conclusion

The analysis presented in this chapter of the study suggests faster and more harmonized digital transformation, as well as more intensive investment in broadband infrastructure would yield significant

[61] Perhaps the share of STEM graduates would be a valuable indicator here; however, comparable data on detailed educational structure of the workforce in the Western Balkans were not available. Mondekar (2017) reports that in both Croatia and Slovenia around 2 percent of the graduates are in the STEM area.
[62] Eurostat reports that the share of the adult population (25–64) participating in education and training in 2016 was only 2.9 percent in The Former Yugoslav Republic of Macedonia, 3.0 percent in Croatia, 3.3 percent in Montenegro, and 11.6 percent in Slovenia. The figures for Austria and Germany stood at 14.9 percent and 8.5 percent, respectively.

economic benefits to Western Balkan economies. These economic benefits would materialize as stronger economic growth, higher employment and labor productivity as well as more intensive regional economic cooperation and more inclusive labor markets. Economic benefits of digital transformation in the region would in turn also facilitate greater societal and political benefits such as greater regional linkages the reduce social and political tensions in the region and draw on existing ties, as will be explored in greater detail in chapter 4.3.

Due to the fact that digital transformation is reflected in different aspects and in a multitude of different variables that measure digital transformation, we have introduced a digitalization index to enable a straightforward interpretation. The index suggests that Slovenia is digitally the most advanced economy in the region, followed by Croatia, Montenegro, Serbia, The Former Yugoslav Republic of Macedonia, Bosnia and Herzegovina, Albania, and then Kosovo*. We have also used this newly constructed index to empirically measure the impact of digital transformation on economic output, employment and productivity. The estimated elasticity implies that a ten percent increase in the digitalization index in the Western Balkans resulted in an average GDP increase of 0.63 percent in the 2005–2015 period. In addition, our findings suggest the effect of faster digital transformation on the GDP is much stronger in Western Balkan economies when compared to an average world economy, thus giving additional motivation for implementing policies promoting more intensive digital transformation in the Western Balkans.

Digital transformation also improves productivity and creates new jobs across both the manufacturing sector and the service sector. An increase of the digitalization index by 1 percent thus corresponds to about 0.67 and 2.12 percent greater productivity in the services sector and manufacturing sector, respectively. At the same time, more intensive digital transformation is associated with new job creation in the Western Balkan manufacturing sector, as a 1 percent increase in the level of digital transformation roughly corresponds to a 1.16 percent increase in employment. The effects are particularly pronounced among knowledge- and technology-intensive firms. From there it follows that for Western Balkan economies to become knowledge-driven societies, the investment in digital transformation, particularly broadband service of high speeds and unlimited use, is the essential precondition. The benefits of digital transformation seem to be more accrued to firms in rural areas than in urban areas. This finding signals that development gaps can be reduced and economic activity revived in remote and rural areas of the region through better access of those regions to the broadband. Finally, the effects of digital transformation in manufacturing seem to outweigh those in service sector firms. Such finding suggests digital transformation may serve as a vehicle for reindustrialization of Western Balkan economies.

The results of input-output exercise suggest investments of 100 million euro could provide a strong stimulus to the Western Balkan economies often characterized by stagnant or mediocre economic growth. Depending on the size of the economy and the level of productivity, a demand stimulus through 100 million euro broadband investments would induce additional GVA in 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 The Former Yugoslav Republic of Macedonia, to 0.9 percent in Albania, and 2.1 percent in Montenegro. Thereby, one has to note that these short-term effects take place in addition to long-term increase in GDP which is a result of faster digital transformation of these economies. Investments in broadband infrastructure could also potentially increase employment in Western Balkan economies. It is thus estimated that broadband investments of 100 million euro could induce new jobs in a range from 3,000 to 10,000, depending on the level of labor productivity of an economy and the share of domestically produced components within broadband investment goods and services bundle. As investments positively affect economic activity, they also induce the increase in government revenues from taxes and contributions. An investment of 100 million euro could thus induce from 15 (The Former Yugoslav Republic of Macedonia) to 47 million euro of additional government revenues in Serbia and Croatia.

The digital landscape is perceived as a possible point of cooperation among Western Balkan economies as “the internet is both a subject of cooperation and a new tool to facilitate cooperation in other realms” (World Bank, 2016, p. 292). At the same time, regional economic cooperation in the Western Balkans can help create regional or gain access to global supply chains, reduce vulnerability and political risk, and increase resilience to external shocks of each economy involved (World Bank, 2016). As evidenced in this chapter, the regional cooperation among economies in the region has been rising, possibly spurred by increased digital transformation convergence that has also been recorded in the region. Consequently, a harmonized and standardized approach to digital transformation across the Western Balkan region would not only stimulate economic cooperation, but also improve the region's investment attractiveness and increase funding from the EU's private sector as well as from the international financial institutions. However, the second-round effects of more harmonized approach to digital transformation go beyond economic cooperation, to include greater political stability, as it requires greater political cooperation that can reduce bilateral tensions. In addition, greater regional integration can facilitate future EU integration as it enhances regional preparedness and also allows for economies of scale, considering the relatively small sizes of economies of the region.

Digital transformation in the Western Balkans would also be beneficial for the labor markets in the region, mainly through an increased access to jobs for some groups (e.g., females, disabled, those in remote areas) who had limited access to labor market previously. Furthermore, through the increase of entrepreneurship and self-employment, faster job creation, new working arrangements can help in balancing work-life arrangements, improved organization of work, increased labor productivity in all sectors and, in the end, an increase of the overall economic output. However, as the World Bank (2016) report concludes “the full benefits of the information and communications transformation will not be realized unless countries continue to improve their business climate, invest in people’s education and health, and promote good governance” (World Bank, 2016, p. xiii). Hence, in order to reap the full benefits from increased digital transformation, this process should be embedded with larger economic and political reforms.

4. Political and Social Dimensions of Digital Transformation

The digital transformation of the Western Balkans has far-reaching implications for the social and political environment of the region, some deriving from the economic aspects outlined in the previous sections, others deriving directly from the opportunities digital transformation offers. The region is and will continue to be shaped by this global transformation. This will include a shift affect all spheres of life, from communication, governance, society and the economy. The question is whether the region will be left behind by these larger trends, or whether the economies and governments can harness them, developing the ability to respond to these trends by utlizing them to the benefit of their societies. If governments and societies in the Western Balkans decide to embrace digital transformation, it can contribute to addressing some of the key deficiencies in terms of governance, such as weaknesses in terms of the rule of law, or more participatory and inclusive governance. It can also help address societal challenges from uneven regional development, brain drain and deficiencies in terms of education.

According to a 2012 study on the global impact of digital transformation, the main political and social impact of digital transformation are the quality of life and access to services, as well as transparency, e-government, and education in the field of governance.[63] Besides these opportunities within the economies, there are potential positive effects if the digital transformation is based both on regional cooperation and embedded in the European integration process, as will be discussed in the subsequent sections of the study. This entails additional political and social benefits that affect the Western Balkans as both a region with a plethora of regional cooperation mechanism and an area of EU enlargement more than others.

The social and economic dimensions of digital transformation are complex and difficult to predict. Thus, forecasts on how many jobs are globally lost and created through digital transformation vary widely (World Economic Forum, 2016). This study shows in chapter 3.5. that if the digital transformation is embraced in the Western Balkans, the gains will clearly outweigh the losses. Assessing the impact on how governments are run and how different groups are included and excluded is based on experience from the region and around world, but it is far from a conclusion. Furthermore, as this study argues, there is no singular discernable path on how economies can cope with digital transformation. An unprepared economy might reap few benefits and suffer considerable consequences, from job losses to the spread of hate speech, as societies and governments are unprepared for economies', media, and social interaction shifts toward the digital.

[63] See Sabbagh et al. (2012).

The social impact of digital transformation on the economies depends largely on the overall level of development of a given economy. More developed economies have displayed a greater correlation between measures of well-being and digitalization scores than less developed economies, as the satisfaction of basic needs like sanitation and electricity trumps the benefits of the digital era (Sabbagh et al., 2012). In the case of the Western Balkans, the economic development varies significantly among the economies, but they all belong to the category of upper middle-income economies (with the exception of Kosovo*).

Not only does the state of the economy matter, but so does the level of digital transformation. There have been three waves of digital transformation, including the first wave that encompassed the introduction of broadband, mobile telecommunications, and computers; the second wave of internet platforms and cloud computing; and the third wave of the Internet of Things (IoT), big data, and machine learning. Each wave of digital transformation has different repercussions on governance and society (Katz, 2017).

When it comes to digital transformation, Section 2 and 3.1. provide ample evidence of weak digital transformation across the region. As evidenced by full and truncated versions of the digitalization index for regional economies displayed in Figures 3 and 4, the region falls into two clusters, with Slovenia, Croatia belonging to the "Transitional Cluster", and the remaining economies being part of a "Constrained Cluster", thus suggesting greater potential for digital transformation. None of the economies have yet reached the third wave of digital transformation, as they mostly belong to the first and second wave.

Table 11. Global impact of digital transformation (+10 point increase in the digitalization index) on governance and society[64]

Governance			
	E-government	E-government index	0.1 points
	Corruption	TI Corruption perception index	1.17 points
	Education	Education index	0.17/0.07 points
Society	Jobs	Unemployment rate	-0.84%
	Innovation	Global innovation index	6.27 points
	Quality of life	OECD better life index	1.29 points
	Access to basic services	UNDP HDI	0.13/0.06 points

Source: Sabbagh et al. (2012).

[64] Data of the education index and HDI are based on combined scores for constrained, emerging, transitional, and advanced economies. Adopted from Sabbagh et al. (2012, p. 17).

A global study of the impact of digital transformation confirms many of the observations noted in section 3 of this study in terms of employment and growth. In addition, there is a positive effect on corruption perception, e-governance and education, as well as measures of social development, as summarized in Table 11.

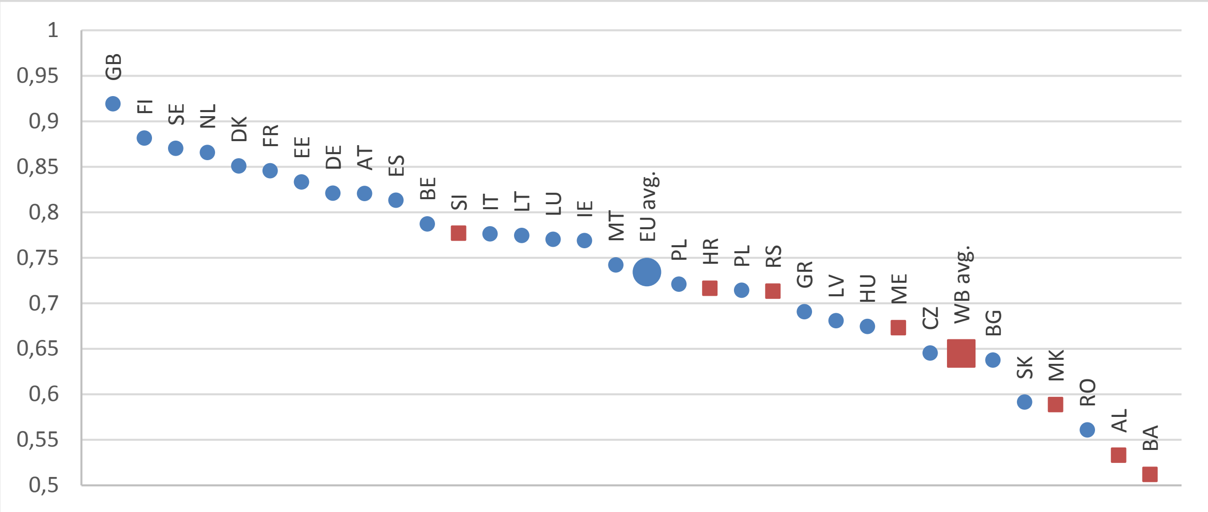
4.1. E-Governance and the Political Implications of Digital Transformation

Governance is directly impacted by digital transformation. Beyond the authorities' need to manage the regulatory framework of digital transformation, governance itself can be transformed through e-governance. E-governance encompasses the use of digital services to enhance government services. These range from citizen and business services provided by a government (such as tax payment, document requests, and registration), to government transparency through digital means (minutes of meetings, public procurement processes and strategies), and to consultative practices (from citizens participation to e-voting). The emphasis on governance (rather than government) highlights that these can be provided in a multiplicity of different levels of government (local to state, by public service provider and regional and international organizations) and that they require the engagement of multiple stakeholders.

E-governance does not just imply a top-down service provision by the state, but it also allows for a more interactive multi-stakeholder approach in policy design and development, and consultation processes.

Currently, the Western Balkans are lagging behind the rest of Europe significantly in the field of e-governance. While Croatia and Slovenia are among the mid- and lower-rank EU member states, the economies outside the EU are placed between the 39th place globally (Serbia) and the 92nd (Bosnia and Herzegovina), see Figure 14.

Figure 14. E-Government index for the EU and the Western Balkans[65]



Source: Authors' calculations.

Enhancing e-governance is closely interlinked with a larger digital transformation of the region, as improved e-governance requires a reliable and comprehensive digital coverage and provision of services to citizens. E-governance is also connected to the human dimension of digital transformation, namely citizens' trust in digital communications and services, from data protection and privacy, to reliability and digital skills.

In return, a shift towards greater e-governance can provide an important stimulus for the economy, as it can improve some of the major obstacles for doing business in the region. These include access to permits, such as water and electricity, and informality and corruption (Sanfey et al., 2016). Empirical evidence suggests that e-governance can have a strong positive impact on fighting corruption (Elbahnasawy, 2014). E-governance allows for procedures that are more transparent and reduce points of contact between citizens and government officials where bribes could be solicited or offered. If one-stop-shops provided an important tool to simplify the interaction between public administration and citizens or businesses, e-governance constitutes a further step in removing opportunities for corruption. Furthermore, e-governance provides for tools that allow citizens to report corruption and thus, it can directly contribute to the battle against corruption. Finally, it increases legal certainty as it becomes easier to access important documents and court orders (cadaster, mortgage, trade register etc.).

Closely intertwined with the potential for greater transparency is the simplification of procedures that e-governance can provide. Reducing queues in administrative offices, and a clear distribution of responsibilities can cut down significantly high administrative burdens citizens and companies often face.

[65] UN (2016).

Thus, e-governance entails considerable opportunities for open government, which entails the public disclosure of documents and materials, as well as the possibility of consultative processes with citizens' participation. Such open government approaches include electronic registries and open budget processes, which remain underdeveloped in the Western Balkans (ReSPA, 2015). An important aspect of e-governance is the digital aspect of voting, which includes e-voting, although this remains challenging. However, digital voting registers and support in vote counting can render voting processes more transparent and facilitate voter participation. However, such digital transformation of political participation requires strong safeguards against abuse and manipulation.

An indirect link between digital transformation and governance lies in the opportunities it provides for SMEs. Recent research on Bosnia and Herzegovina shows that local business associations, based on a diverse local business sector can have a positive impact on local government in terms of being able to push for better governance and greater transparency (Karamperidou, 2018). There is thus a benefit for governance from SMEs, especially at the local level, as a diverse group of companies have an interest in transparent governance and good service provision, whereas quasi-monopolistic companies are able to establish working relations with local governments that bypass larger questions of good governance. Digital transformation can contribute to the development of a decentralized and diverse economy by providing benefits to companies outside capitals and enhancing market access to smaller companies, such as start-ups.

Finally, digital transformation will have a large impact on media in the Western Balkans. Digital media have already become the second most important source of information in Serbia, a trend that is likely to be similar elsewhere in the Western Balkans. In 2016, internet was the most important source of information for 36.8 percent of the population, with the share of TV shrinking by nearly a quarter between 2010 and 2016. The time spent using the internet is second only to watching TV (175 minutes to 317 minutes per day) (BIRN & Reporters without Borders, 2016). Thus, digital media already shape citizens' perception and provide news. With further digital transformation of the Western Balkans and with new digital generations coming of age, there is a likely further shift in importance from the prevailing dominance of television to online media.[66]

Digital media and social networks are important alternative sources of information in media markets that are often shaped by politicized news outlets and insufficient independence from governments and state funding (Bieber & Kmezić, 2015). Thus, the reduced costs and speed dissemination of electronic

[66] For more details, see the "Mapping Digital Media" project of the Open Society Foundations.

media provide for a potential critical voice in many economies to report critically and independently and can thus contribute to better governance.

The downside of the low-cost, high-impact electronic news dissemination has also become visible through the proliferation of “fake news” which many media consumers are not able to distinguish from real news and news distribution through algorithms on social media, which results in echo chambers and proliferation of unrestricted hate speech. Despite these trends, in Serbia, social networks and the internet enjoy high levels of trust, more than any other type of media (BIRN & Reporters Without Borders, 2016).

Digital transformation can thus prompt greater trust in the media and a more diverse media scene that can lead to improved governance. At the same time, without greater management of online content and digital literacy, the media dimension of digital transformation can also have a disruptive effect on governance.

4.2. The Societal Impact of Digital Transformation

Digital transformation encompasses far-reaching changes for societies, form the way citizens consume their news, as just discussed, to their workplaces and education. Being embedded in European economic structures, the response of the governments and society at large will determine whether social impact of digital transformation will be beneficial.

As the Western Balkans are in terms of digital transformation laggards in a European context, larger European and global challenges apply to the region. These include the increasing blurring of private and work life, less predictable and stabile work relations, based on greater mobility and potential autonomy. There will be winners and losers in the job shifts as a result of the digital transformation and social preparedness is central (World Economic Forum, 2016, pp. 14–15).

First, digital transformation has the potential to include groups that have been excluded from the workforce, either based on residence or gender, as discussed in greater detail in section 3.3 and 3.5. The Western Balkans are marked by a low rate of women participating in the work force: 7 percent below the EU average of 45 percent, and with little change over the past decade. As a recent IMF study shows, the main causes of the low rate lie with family responsibilities, relatively lower levels of education, as well as disincentives in the field of employment and taxation (Atoyan & Rahman, 2017). Digital transformation can contribute, as this study and others (World Bank, 2017b) have argued, to the enhancement rates of women participation in the economy. Beyond the economic benefits, there are also social and political benefits. Women are dramatically underrepresented in politics and other leadership positions, and women are more frequently subject to discrimination and violence (Lilyanova, 2017). Thus, improving the position of women is one large transformative challenge for the Western Balkans. Providing greater access to employment can thus develop knock-on effects for the larger social and political structure.

Second, regional development in the Western Balkans is highly uneven. Rural and peripheral areas are greatly lagging behind the capitals and larger urban areas. This trend has been exacerbated by the economic developments in the region, with investments often focusing in centers, and previously state-supported regional industries closing down. This has resulted in greater rural poverty as well as migratory trends toward capitals and abroad (Bartlett, 2009). As this study highlights, even though firms in urban areas generate more jobs, an overall increase in broadband connectivity exhibits larger positive effects on employment and productivity in rural firms when compared to firms located in more urbanized areas. This, in turn, suggests that placing an emphasis on stimulating broadband investments in white areas of Western Balkan economies could decrease economic inequalities and spur local economic development, which is in line with EU cohesion policy aiming to reduce regional disparities in income, wealth, and opportunities.

Third, digital transformation is likely to have an impact on migration, a defining feature of social structures in the Western Balkans. Following multiple waves of emigration over the past century, large numbers of citizens continue to leave their homes, in particular for the economies of the European Union. Between 2010 and 2015 nearly a quarter of a million citizens left the Western Balkans (246,000) (World Bank Group & WIIW, 2017, p. 5). This migration has a significant impact on societies, economies, and politics of the Western Balkans. While it provides for a safety valve for high unemployment rates and provides for remittances, it also results in labor shortages among key sectors of the economy and leads to overall population decline. Even remittances, while sustaining many families in the Balkans, have negative features, as they are often used for consumption and might constitute a form of a resource curse, unlinking citizens from government policy. Thus, both the reduction of continuous emigration and harness of migrants outside the economies of the Western Balkans are important challenges. Shrinking and aging populations (with the exception of Kosovo* and Albania) increase pressure on welfare institutions and other services (The Economist, 2017). Digital transformation can contribute to both linking immigrants to their economies of origin, including the creation of brain circulation through new digital workplaces. Furthermore, digital transformation facilitates teleworking and other forms of work that are less connected to a traditional workplace, providing a potential to reduce migration and re-connect migrant communities.

In addition to labor, the largest societal impact of digital transformation will be reflected on education, as outlined in Chapter 3.5. Digital transformation provides for important opportunities in the educational sector. First, it allows for the effective deployment of digital infrastructure in schools. This is particularly salient as studies throughout the Western Balkans show that the workforce lacks the necessary skills and that the educational systems provide students with either outdated or ill-fitting skills. The digital transformation of the Western Balkans can contribute in addressing this mismatch between skills required by employers and the skills provided through education in the region.[67] In addition, education can be communicated at a relatively lower cost to a broader audience through online courses and MOOCs.

To fully reap the benefits of digital transformation, firms may require that their current employees acquire new skills (CEPS, 2016, p. 43). As people in the labor market today will remain part of an increasingly digital labor market for at least three more decades, there is a need to provide training and life-long learning to avoid the creation of long-term unemployment among the workforce without digital skills (EC, 2017, p. 11).

4.3. Regional Cooperation and Digital Transformation

Regional, economic, political, and social integration can be enhanced through digital transformation and is grounded on regional digital integration. Following the collapse of regional economic integration during the wars of the 1990s, the economies of the Western Balkans have reestablished economic ties that have gained strength over time. As evidenced by Figure 11 in Chapter 3.4.1. regional economic cooperation indeed gained momentum and has a clear upward trend which was briefly interrupted by the Great Recession in 2008. Stronger economic cooperation among regional economies, mostly based on trade of goods and services, has reemerged in spite of sporadic political tensions and even across contested borders. In addition, as discussed earlier in this study, more intensive economic cooperation was followed by greater degree of digital transformation convergence stemming from regionally more equalized rates of internet usage and broadband subscription.

While some transnational infrastructures have decayed and declined in speed and quality since the 1980s, such as railways, other new infrastructures have been built, especially roads. However, regional economic cooperation and integration is still lagging behind its potential. As the World Bank noted in 2017, regional integration is an important aspect of improving the socio-economic situation in all the

[67] For more details, see the reports of the European Training Foundation, "Skills 2020" (2014): reports on Albania, The Former Yugoslav Republic of Macedonia, Kosovo*, Serbia, Montenegro, Bosnia and Herzegovina.

economies. There are obvious economic benefits to such regional cooperation, such as greater economies of scale and the creation of regional supply chains (World Bank, 2017a), as discussed in this study in Chapter 3.4. In addition, there are larger political and social dimensions to integration, in particular in the field of digital transformation. Increased digital connections facilitate cross-border trade and thus promote mutual economic integration. With strong cultural connections and cross-border linguistic communities, the benefits and opportunities of increased cross-border trade, as well as cooperation, are obvious. As described by the British journalist Tim Judah as the ”Yugosphere“ a decade ago, the multiple ties among the economies of the Western Balkans are based on historical connections and cultural, social and economic links (Judah, 2009). Similar to cooperation among Albanian-speaking citizens, language and what has been called ”cultural intimacy”, facilitates cooperation, even when it crosses state borders. Via the creation of additional synergies, this can enhance and reinforce the existing structural and economic advantages of cooperation. Furthermore, regional cooperation, including the field of digital transformation, can also contribute to confronting regional challenges, and thereby designing solutions and instruments that will spur the political, societal and economic development of the entire region.

Regional relations are still fraught by the legacy of the wars of the 1990s. A number of bilateral disputes remain unresolved, as the 2018 European Commission strategy for the Western Balkans also notes: "all countries must unequivocally commit, in both word and deed, to overcoming the legacy of the past, by achieving reconciliation and solving open issues well before their accession to the EU" (EC, 2018, pp. 6-7).

While digital networks, just like roads, only constitute the ”hardware“ of regional cooperation, and need to be filled with the software of people-to-people contacts, they are an important prerequisite for growing links.

Closely connected is a rising demand and need for cross-national digital cooperation. This concerns the exchange of data in the fields of healthcare and other registers. These are particularly significant in the context of information exchange within the EU, but also bilaterally. Here, economies with larger numbers of nationals abroad, as is the case with most of the Western Balkans, are particularly concerned. Thus, closer digital cooperation and integration between the economies is likely to become of increasing importance (Sangder, Smolander, Korhonen, & Rissanen, 2016). Such regional connectivity and e-governance links also facilitate mobility among citizens, as government services become more accessible for mobile citizens and reducing barriers on access to services from health care to pensions and social benefits.

Digital transformation is closely intertwined with multi-layered governance and the idea that governance is not restricted to a singular national government, but multiple actors, be they local or regional units, as well as international actors that are involved in governing. Here, digital transformation is enabling the emergence of transnational and cross-border cooperation. The Baltic region provides for insight on the possibilities for regional digital cooperation and its benefits. These include: sharing of best practices, cooperation on digital initiatives, and data exchange (Aruoja, 2015).[68]

4.4. European Integration and the Potential Benefits of Digital Transformation

The digital transformation of the Western Balkans is a crucial component of the EU integration process of the region. While all the economies of the region strive to join the EU and the EU is committed to the prospect of enlargement, serious obstacles remain to ensure accession. These include: pursuing the political and economic transformation of the region to ensure adequate preparedness for membership, addressing a number of unresolved political disputes, and finally convincing EU member states of the merits and readiness of the accession economies. In this process, digital transformation will be significant for four reasons: a) ensuring digital compatibility of the region, b) fostering economic readiness, c) ensuring a qualitative leap forward in terms of the rule of law, and d) rule-based government and regional cooperation.

First, engaging digital transformation in the Western Balkans is directly connected to ensuring the compatibly with the EU digital single market and thus preparing the economies for EU accession. Indirectly, the aforementioned dynamics, economic and political, can be beneficial for ensuring the preparedness of the economies for the EU membership.

The EU digital single market strategy is currently seeking to prepare the EU for digital transformation. This includes measures in enhancing citizens' access to digital goods and services, an improved regulatory environment and policies, which make sure that the digital transformation provides maximum social and economic benefits, including harnessing the strengths and addressing the challenges arising from the digital transformation.

In preparation for EU accession, the economies of the Western Balkans also need to converge with the EU digital single market to ensure that at the latest by the time of accession, the economies can be

[68] See For more information see the "Digital Baltic - Digital Innovation in the Baltic Sea Region" website at: http://digitalbaltic.eu/, and Estonia's X-Road at: https://e-estonia.com/solutions/interoperability-services/x-road/.

fully participating in the single market and that their ICT and relevant policies are compatible with and integrated into the EU's.[69]

Second, beyond the direct impact on the EU, digital transformation constitutes an important aspect of advancing the economies' membership by enhancing the preparedness of the economies for the single market of the EU. The EC strategy for the Western Balkans, as stressed earlier, notes that the economies cannot be considered to have functioning markets and be able to deal with the EU market forces (EC 2018). As this study outlines, the economies of the Western Balkans are not competitive with the EU in the digital sector either.

As digital transformation proceeds globally and other European economies are better prepared to take advantage thereof, there is a high risk that the Western Balkans will be left behind, resulting in an increasing digital gap. This will severely undermine the ability of the economies to build functioning market economies that are able to sustain the pressures and requirements of EU membership.

Third, the economies of the region display considerable shortcomings in the fields of the rule of law and good governance that will need to be addressed prior to the membership. Over the past decade, the EU has put the rule of law at the center of its enlargement when it comes to the Western Balkans. This emphasis has been underlined in the recent European Commission Strategy for the Western Balkans. The Commission correctly observes that the elements of state capture exist in all economies and that corruption and political interference constitute serious obstacles to EU accession in the region. The Commission particularly names e-procurement as a strategy aimed at reducing the risks of abuse and ensuring transparency, yet the links with e-governance are broader, as outlined in this study. The use of digitalization in public administration and state institutions fosters rules-based policy making and administering, as opposed to reliance on discretion, which is characteristic of the region. To the extent that e-governance is impersonal, it is almost by technological necessity rule-based, and thus has both lower transaction costs, e.g. expressed in bribes or kickbacks of one kind or another, and is more open to new entrants. In using the full tool kit of e-governance outlined in this study, the governments of the region are able to leapfrog over the shortcomings of the rule of law. These do not only help advance EU accession directly, but will also produce indirect benefits such as improving the business environment and thus contributing to the economic preparedness of the economies as well.

Finally, a regional digital transformation can support the necessity of multi-layered regional cooperation, as argued in this study's discussion of the economic, political, and societal aspects of regional

[69] This is also explicitly mentioned in EC (2018).

digital cooperation. The European Commission emphasizes the need to address open regional and bilateral issues, as well as to build a higher level of regional connectivity and integration, leading to the regional economic area as "an essential step for furthering economic integration between the EU and the Western Balkans and boosting the attractiveness of the regional market" (EC, 2018, p. 12).

4.5. Conclusion

Beyond the economic effects of digital transformation, there are substantial benefits in the fields of governance, its social impact, as well as on regional cooperation and European integration. In all these fields, there are direct consequences of increased digital transformation and indirect consequences, as outlined in table 12. The indirect effects of digital transformation extend well beyond the immediate benefits. As this chapter suggests, the main indirect benefit consists of greatly enhancing the reforms that are essential to make the societies ready for EU membership.

Table 12. Impact of increased digitalization in the Western Balkans

Dimensions of Digital Transformation	Direct	Indirect
Governance	E-governance	Transparency and corruption
	Online media	Empowering agents of good governance
Society	Education	Inclusion of the disadvantaged and marginalized groups
		Support brain circulation
Regional cooperation	Cross-border e-governance cooperation	Improved citizen-citizen contacts
	Cross-border business clusters	
European integration	Joining the digital single market	Preparedness for a competitive pressure and market forces in the EU
		Greater preparedness in the field of rule through e-governance
		Support regional cooperation, including a regional economic area

Source: Authors.

These implications arise not just from a technical improvement of the digital infrastructure, but mainstreaming the digital transformation into governance and society more broadly. Thus, improved digital infrastructure provides for the foundation on which effective E-governance, education using digital resources, regional cooperation and leapfrogging European integration. These effects will not materialize by themselves, but require a comprehensive digital strategy of governments, in cooperation with other stakeholders (business, civil society and regional and international organizations) to maximize the benefits. The process of European integration, shared among the Western Balkans as a shared goal, provides for a framework to bring the different strands digital transformation together. In particular, the link between e-governance, based on the benefits of reducing the opportunities for corruption and advancing standard procedures feeding into the rule of law both advance the EU integration of the region, and encouraging economic development based on improved regulation and digital infrastructure can create a mutually reinforcing dynamic.

5. Conclusion

Digital transformation cannot be a silver bullet for resolving all the challenges in economy and governance the region is facing, yet it can make a significant contribution. The digital gap of the region to the EU average is clear and encompasses most economies in different indicators of digitization. Without a clear and strategy intervention by governments, business, civil societies, and with support by the EU and regional organizations, this gap is likely to remain or increase.

As this study demonstrates, digital transformation, if managed and harnessed by the governments of the Western Balkans, has cascading effects that extend well beyond the narrow scope of the digital. It can result in economic growth, increase employment and bring marginalized communities into the workforce. The direct and indirect benefits for the economy and labor market are extensive. Furthermore, the study has highlighted the political and social benefits for greater engagement with digital transformation. Especially in the sphere of e-governance, the use of digital tools to provide citizens' services can greatly contribute to the rule of law, reduce potential for corruption and advance standardized government engagement with citizens and businesses that stymie the prevalence of nepotism and patrimonial structures, from e-procurement to open budgeting.

If all key stakeholders embrace digital transformation as a regional project, it can strengthen ties within the Western Balkans, making the region more resilient to bilateral tensions contributing to growing regional networks of cooperation.

As a clear majority of the population of the Western Balkans aspires to join the EU, digital transformation is an important tool to advance this goal. Only the transformation of the region into functional market economies, driven by rule of law driven governance can realistically aspire to membership in the EU in the coming decade. Achieving this transformation requires a paradigm shift that necessities drawing on digital transformation.

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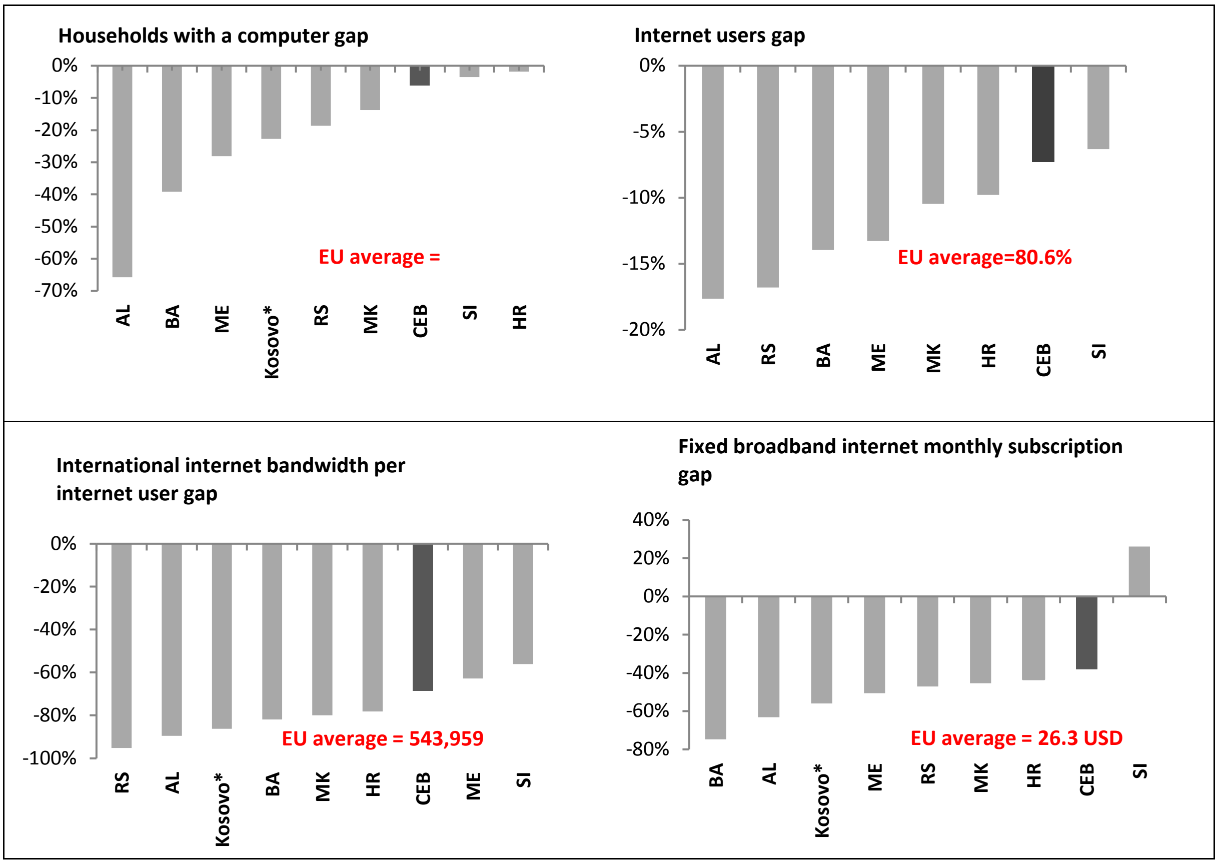
APPENDIX A. CURRENT STATE OF DIGITAL TRANSFORMATION IN THE WESTERN BALKANS

Figure 1a. Digitalization gaps in the Western Balkans in 2016



Notes: CEB stands for Central Europe and the Baltics; MK stands for The Former Yugoslav Republic of Macedonia.
Sources: ITU (2017b), Pew Research Center (2015), Agency of Statistics of Kosovo*(2016) and Regulatory Authority of Electronic and Postal Communications for Kosovo* (RAEPC).

Table 1a. List of national broadband polices

Economy	Policy Available	Year the policy was adopted	Title
AL	Yes	2013	National broadband plan
BA	Yes	2008	Decision on the telecommunication sector policy of B&H 2008–2012
HR	Yes	2011	National broadband development strategy in the Republic of Croatia 2011–2015
Kosovo*	Yes	2012	Electronic communication sector policy: Digital agenda for Kosovo* 2013–2020
MK[70]	Yes	2005	National strategy for the development of electronic communications
ME	Yes	2012	Strategy for the development of information society 2012–2016
RS	Yes	2009	Broadband access development strategy in the Republic of Serbia until 2012
SI	Yes	2008	Broadband network development strategy in the Republic of Slovenia 2008

Source: ITU (2017a).

[70] The Former Yugoslav Republic of Macedonia.

Figure 2a. Relationship between selected indicators of digital transformation and GDP per capita, in USD

Figure 2a.1. Households with internet access and GDP per capita

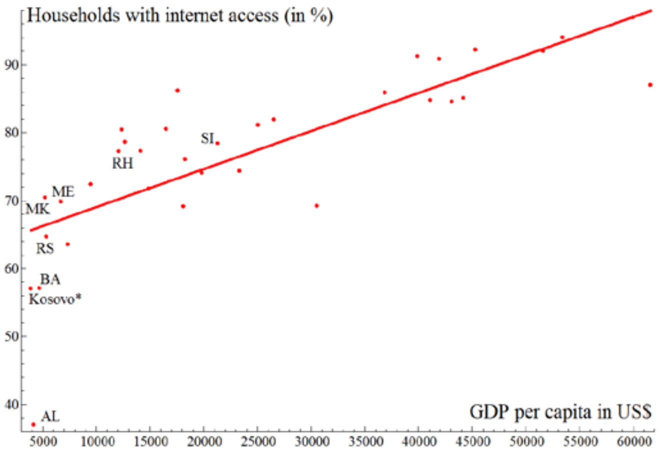


Figure 2a.2. Mobile-cellular subscriptions per 100 inhabitants and GDP per capita

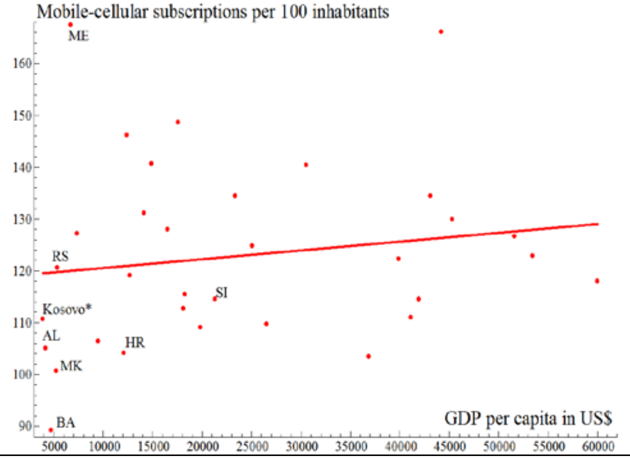


Figure 2a.3. Fixed broadband subscriptions per 100 inhabitants and GDP per capita

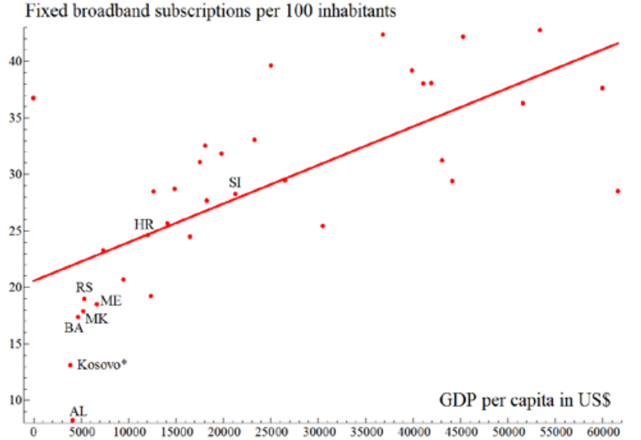


Figure 2a.4. Internet bandwidth traffic per user and GDP per capita

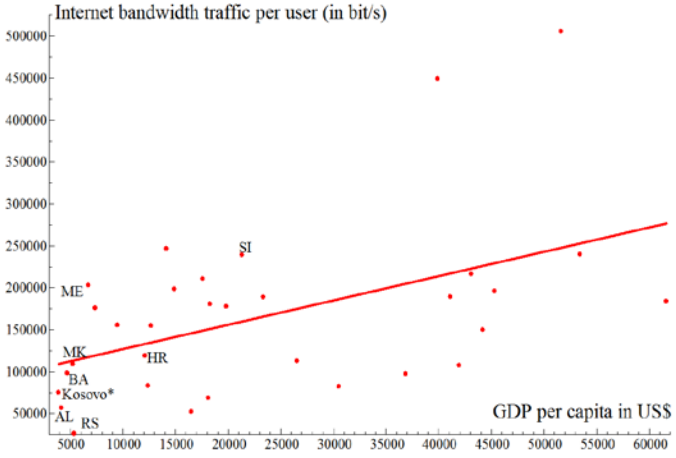


Figure 2a.5. Households with internet access and investment in telecommunication services per revenue

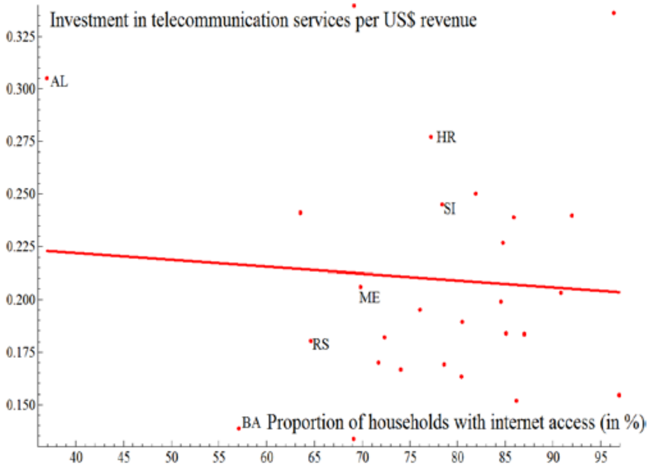
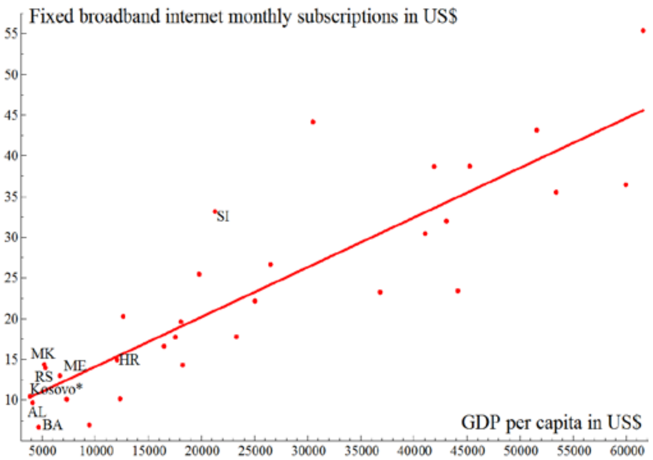


Figure 2a.6. Fixed broadband internet monthly subscriptions and GDP per capita



Note: MK stands for The Former Yugoslav Republic of Macedonia.

Sources: Authors' calculations based on ITU (2017) and World Bank (2016), Agency of Statistics of Kosovo*(2016) and Regulatory Authority of Electronic and Postal Communications for Kosovo*(RAEPC

Unmarked dots represent values achieved by EU economies, while values for Western Balkan economies are marked with a two-letter code. The red line represents the regression line which describes the selected digital transformation indicator as a function of economic development. If an economy is placed above the line for a certain indicator, this means it records a higher level of digital transformation than what would be warranted by its development level. The opposite applies if an economy is placed below the line.

Table 2a. Parafiscal charges related to broadband investments in Western Balkan economies

Economy	Parafiscal charges
BA	Fees for road and building land, legalization fees, communal fees varying from town to town, fees for local water systems, fees for real estate objects, fees for inspectors
HR	At least 23 different fees paid to electricity operators, water providers, state roads operators, local road operators, railways, several ministries, local government, several public companies, use of land fee, servitude fee.
MK[71]	Administrative taxes for providing building permits, taxes for administration of the constructional land, taxes for transformation of agriculture into constructional land, taxes for civil work in urban areas, monitoring fee, universal services fee, film fund fee, media agency fee.
ME	Environmental approval fees, waste disposal fees, local communal fees, state road fees for cables and devices, municipal road fees for cables and devices, fee for digging cables out of road and placing in road, fee for ecology license when obtaining construction permits, and fees for obtaining construction permits
RS	Fee for the issuance of location conditions, contribution for the development of construction land, fees for issuing of technical conditions and consents from different holders of public authorizations, fee for issuing a building permit, fee for issuing a use permit, land cadaster fee.

Source: Western Balkan telecommunications companies survey (authors' construction).

[71] The Former Yugoslav Republic of Macedonia.

APPENDIX B. DIGITALIZATION INDEX

The calculation of the digitalization index follows the methodology proposed by Sabbagh et al. (2012) and Katz and Koutroumpis (2013). It uses factor analysis to derive the index from 16 digitalization indicators divided into six digitalization categories: affordability, infrastructure reliability, network access, capacity, use, and human capital. Table 1b presents six digitalization categories and their corresponding indicators.

Table 1b. Data sources and definitions of digitalization index components and other variables used in the analysis

Category	Indicator	Source
Affordability	Residential fixed line monthly subscription adjusted for GDP per capita	ITU
	Residential fixed line connection fee adjusted for GDP per capita	ITU
	Mobile cellular prepaid tariff adjusted for GDP per capita	ITU
	Fixed broadband internet monthly subscription adjusted for GDP per capita	ITU
Infrastructure reliability	Investment per telecom subscriber (mobile, broadband, and fixed)	ITU
Network access	Broadband penetration	ITU
	Percentage of the population covered by a mobile-cellular network	ITU
	Percentage of households with a computer	ITU
	Percentage of the population covered by at least a 3G mobile network	ITU
Capacity	International internet bandwidth (in bit/s per internet user)	ITU
	Fixed broadband speed (in mbit/s)	ITU
Use	E-government web measure index	UN
	Percentage of individuals (users) using the internet	World Bank
	SMS use (average SMS sent by customers)	ITU
Human capital	Skilled labor (labor force with more than a secondary education as a percentage of the total labor force)	World Bank
	Human capital index	UN
Dependent variable	Gross domestic product (current USD)	World Bank
Indicator for capital	Gross fixed capital formation (current USD)	World Bank
Indicator for labor	Labor force, total (15+)	World Bank

Source: Adapted from Katz and Koutroumpis (2013).

Factor analysis is a statistical inter-dependency technique used to decrease the number of variables, or factors, that successfully describe the observed variable. For example, using the factor analysis we can decrease the number of sub-components, variables that describe the variable of interest, from 16 to only, e.g., five factors. The observed variable is then modelled as a linear combination of the five latent factors with an added error term. The factor analysis model can be written as:

$$X = \Lambda * F + \varepsilon,$$

where X is a p-element vector, Λ a p x k matrix of loadings, F a k-element vector of scores and ε a p-element vector of errors. The restriction of the method is that the scores must not be correlated and that they have unit variance. The errors are independent with variances Ψ. The correlation matrix of X, or the resulting component correlation, is given by $\Sigma = \Lambda\Lambda' + \Psi$. Assuming multivariate normality over the error term, the fit of the model is obtained by optimizing the log likelihood, given starting values. Table 2b presents estimation results and the corresponding factor loadings. Only the first two decimal places are reported for each loading, and the loadings below 0.5 have been discarded in the analysis, as we are interested in indicators with higher impacts. By doing that, we have left out five indicators and were left with 11 most important indicators that we used to calculate the index.

Table 2b. Factor loadings for the factor analysis

Indicator	Factor	1	2	3	4	5
Mobile tariff		-0.74	-	-	-	-
Investment per user		0.64	-	-	-	-
Computer share		0.95	-	-	-	-
Internet use		0.89	-	-	-	-
Broadband tariff		-	-0.82	-	-	-
Mobile share		-	0.95	-	-	-
E-government index		-	-	0.78	-	-
Human capital index		-	-	0.99	-	-
Phone subscription		-	-	-	0.98	-
Phone installation		-	-	-	0.55	-
Broadband speed		-	-	-	-	0.64
Cumulative percentage of total variance		23	36	49	61	64

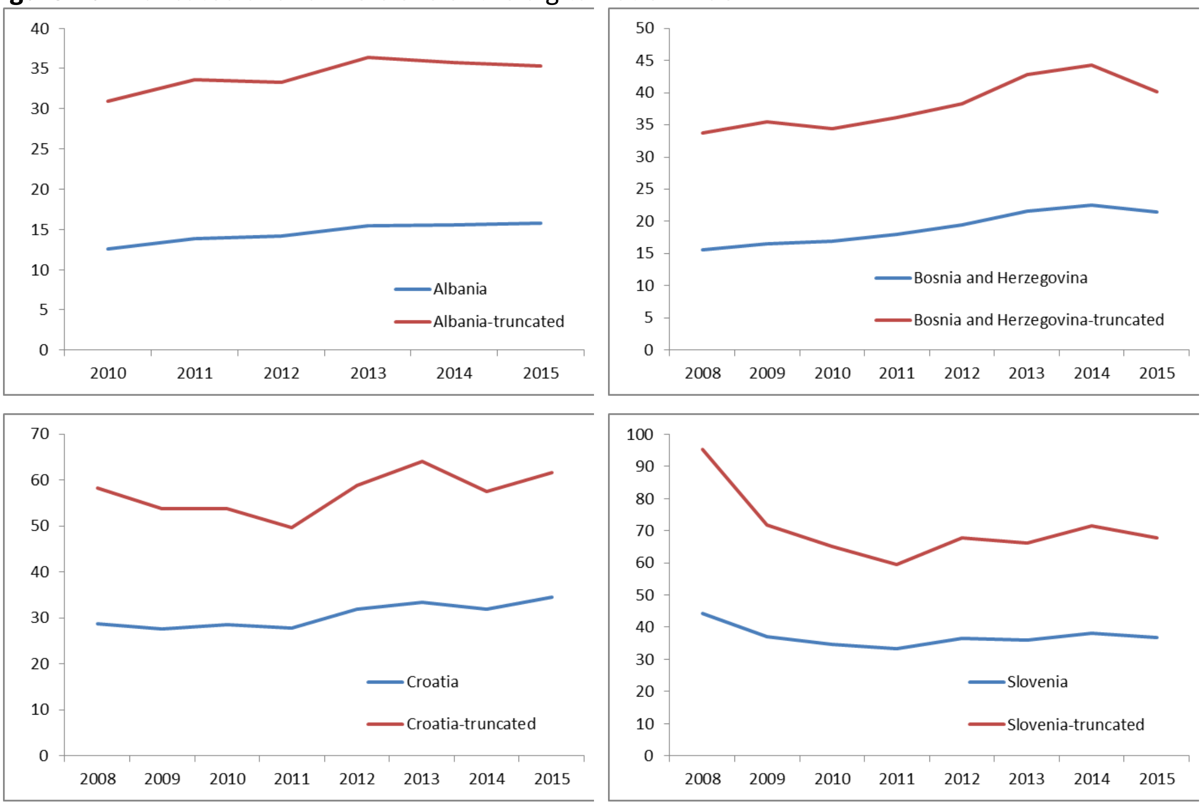
Source: Authors' calculations.

The index is calculated as a weighted average of factor loadings, weighted by the share of variance for each factor in the total variance (equal to 64 percent in our case), or by the following the equation:

$$Index_{it} = \left(\frac{23}{64}\right) * \left(-0.74 * Mobile\ tariff_{it} + 0.64 * Investment\ per\ user_{it} + 0.95 * Computer\ share_{it} + 0.89 * Internet\ use_{it}\right) + \left(\frac{13}{64}\right) * (-0.82 * Broadband\ tariff_{it} + 0.95 * Mobile\ share_{it}) + \left(\frac{13}{64}\right) * (0.78 * E - government\ index_{it} + 0.55 * Human\ capital\ index_{it}) + \left(\frac{12}{64}\right) * (0.98 * Phone\ subscription_{it} + 0.55 * Phone\ installation_{it}) + \left(\frac{4}{64}\right) * 0.64 * Broadband\ speed_{it}.$$

Due to the fact that the 11 indicators suggested by the factor analysis were not available for all Western Balkan economies in our sample, we also calculated a truncated version of the digitalization index available for all Western Balkan economies. The truncated version of the index corresponds to the above equation, but since a fixed broadband internet monthly subscription adjusted for GDP per capita, percentage of households with a computer, e-government web measure index, and human capital index were not available for Kosovo*, Montenegro, Serbia and The Former Yugoslav Republic of Macedonia, the truncated version of the index leaves out these four indicators together with their weighted loadings. Figure 1b shows both the full and the truncated versions of the index for Albania, Bosnia and Herzegovina, Croatia, and Slovenia—the four economies for which both versions of the index are available. This simple exercise serves as a plausibility test for the truncated approach, and we can clearly see that the truncated version of the index follows the dynamics of the full-indicator index, although the level is arguably not the same.

Figure 1b. Truncated and full versions of the digitalization index



Note: The x-axis presents years for which the index is available in both versions, and the y-axis presents the standardized value of the index.

Source: Authors' calculations.

Compounded annual growth rate (CAGR) is defined by Koutroumpis (2009) and calculated in the following way: $CAGR_D = \left[\left(\frac{\frac{D_t}{100-D_t}-\frac{D_{t-1}}{100-D_{t-1}}}{\frac{D_t}{100-D_t}}\right)\alpha_3 + 1\right]^{1/2}$.

APPENDIX C. MICROECONOMIC AND SECTORAL EFFECTS OF DIGITALIZATION

To investigate how digital technologies influence firm performance and employment, a model is developed that brings together firm productivity, sales revenues, and employment with firm characteristics, features of their environment and indices of access to digital infrastructure. In line with a conventional approach to the modeling of digital infrastructure effects, the baseline of our model is the Cobb-Douglas production function with three components, namely, capital, labor and material. Model also controls for within and between (localization and urbanization) agglomeration externalities. The former refer to industry-specific benefits of agglomeration, such as access to skilled workforce, or the proximity of specialized research facilities and a potential for resource pooling with firms from same industry. The urbanization externalities refer to the availability of resources beneficial to all industries within certain geographic area, such as physical infrastructure, cultural and ethnic diversity and pool of labor force. The model also controls for the ownership status of the firm, location in urban and rural areas, technological intensity of industry, economy, and year effects.

Information on firms' characteristics is obtained from Orbis, a pan-European firm-level database provided by Bureau van Dijk, and the information on the five digitalization aspects (broadband speed, international bandwidth, user allowance, the cost of broadband access, and broadband penetration) is obtained from the ITU World Telecommunications Database. Finally, in the construction of technological- and knowledge-intensity variables we rely on Eurostat's classification of technological intensity of the manufacturing industries and the knowledge intensity of services at a three-digit level of NACE Rev. 2 classification. In total, we deal with 185,811 firms over the 2010–2015 period, of which 39,148 belong to the manufacturing sector, and 146,711 are situated in the service sector across six Western Balkan economies (Slovenia, Croatia, Serbia, Bosnia Herzegovina, Montenegro, The Former Yugoslav Republic of Macedonia). Due to the fact that the Orbis database does not provide adequate coverage of Albanian and Kosovo* firms, these two economies were excluded from the sample. In total, the sample includes 680,894 observations distributed over all industries within the manufacturing and service sectors. As data on the digitalization index are not available for The Former Yugoslav Republic of Macedonia for the 2010–2015 period, the sample used for the estimation of the effect of the overall digitalization progress on firm performances was reduced to 159,686 firms. Definitions and sources for all variables used in this segment of the analysis are enlisted in Table 1c.

Table 1c. Data sources and definitions used in the the analysis

Variable	Description	Source
Productivity	Dependent variable: Labor productivity (sales revenues/number of employees) of a firm *i* in period *t*	Orbis database
Sales revenues	Dependent variable: Sales revenues in thousands euro of a firm *i* in period *t* (deflated)	Orbis database
Number of employees	Dependent variable: Number of employees in a firm *i* in period *t*	Orbis database
Capital	Tangible fixed assets in thousands euro in a firm *i* in period *t* (deflated)	Orbis database
Labor costs	Unit labor costs (costs of employees/sales revenues)	Orbis database
Material costs	Unit material costs (costs of employees/sales revenues)	Orbis database
Localization externalities	Firms belonging to the same three-digit level of NACE Rev. 2 industry/number of firms in a given municipality and year	Orbis database
Urbanization externalities	Number of firms in a given municipality/number of firms in a given country and year	Orbis database
Foreign ownership	Categorical variable: 1 if at least 10% ownership is held by a foreign entity	Orbis database
Location of a firm in a urban/rural area	Categorical variable: 1 if a firm is located in a city/municipality with at least 30,000 inhabitants	Orbis database
Broadband speed	Categorical variable: 1 if a firm has access to broadband speed of at least 10 mbit/s	TUI
International bandwidth	Minimum broadband speed guaranteed to users in an international network	TUI
Monthly use allowance	Categorical variable: 1 if unlimited use of internet is provided	TUI
Monthly cost of broadband	Monthly price per 1GB package	TUI
Broadband penetration rate	Proportion of households with access to broadband	TUI
Technological intensity	3 categorical variables taking the value of 1 if a firm operates in a medium-low, medium-high, and high technology-intensive manufacturing industries (low technology-intensive base category)	Orbis database/ Eurostat
Knowledge intensity	Categorical variable: 1 if a firm operates in a knowledge-intensive service segment	Orbis database/ Eurostat
Interaction (speed*htech intensity)	Categorical variable: 1 if a firm has access to broadband of at least 10 mbit/s and operates in high technology-intensive manufacturing industries	Orbis database/ TUI
Interaction (allowance*htech intensity)	Categorical variable: 1 if a firm has unlimited data allowance and operates in high technology-intensive manufacturing industries	Orbis database/ TUI
Interaction (speed*know intensity)	Categorical variable: 1 if a firm has access to broadband of at least 10 mbit/s and operates in a knowledge-intensive service sector	Orbis database/ TUI
Interaction (allowance*know intensity)	Categorical variable: 1 if a firm has unlimited data allowance and operates in a knowledge-intensive service sector	Orbis database/ TUI

Interaction (speed*urban)	Categorical variable: 1 if a firm has access to broadband of at least 10 mbit/s and is located in a municipality with at least 30,000 inhabitants	Orbis database/ TUI
Interaction (allowance*urban)	Categorical variable: 1 if a firm has unlimited data allowance and is located in a municipality with at least 30,000 inhabitants	Orbis database/ TUI

Source: Authors' construction.

The prevalent approach in the analysis of the effects of digital infrastructure deployment relies on the fixed effects panel estimation technique. While being superior in many ways, such technique suffers from one major drawback that prevents its use in this analysis. The fixed effects technique is not convenient for models that include categorical variables, as by definition these are being eliminated in the process of estimation. Our model belongs to such category. Even more, its categorical variables include some of the measures of digitalization which would be eliminated this way. For this reason, we reverted to an alternative in the form of a between-panel estimation technique. In the general form, the starting point in the development of the between-panel model is:

$$y_{ir} = \alpha + x_{it} * \beta + v_i + u_{it}, \quad (1)$$

where v_i is the unit-specific error term whose value is constant for each unit but differs between units and u_{it} is the idiosyncratic error term. Supposing the validity of equation (1) it must also follow that:

$$\bar{y}_i = \propto + \bar{x}_i * \beta + v_i + \bar{u}_i, \quad (2)$$

where $\bar{y}_i = \sum_t y_{it}/T_i$, $\bar{x}_i = \sum_t x_{it}/T_i$, and $\bar{u}_i = \sum_t u_{it}/T_i$. Unlike fixed effects estimators, the between-effect estimator does not treat v_i as an estimable fixed component of the model but rather as part of an error term. There are several reasons that make this estimator more appropriate for our analysis than its alternatives. Between-effects estimators are mostly used when the interest lies in the effect of changes between units rather than within units. Such effects often have a permanent rather than a transitory nature. The primary aim of our analysis is to investigate how performance and employment differ among firms with access to digital infrastructure of different levels of advancement, e.g. the change that occurs between units. The between estimator places emphasis on cross-sectional variation between units (firms, industries, economies etc.), which is coherent with properties of our sample (strong cross-sectional variability and little or no temporal variability).

In order to take into account sectoral differences, the model is estimated separately for the manufacturing and service industries, and controls are applied for economy effects, cross-sectional (annual) shocks that may affect all units, and differences in technological intensity within a three-digit NACE sectors to which the analyzed firms belong. Subsequent developments of the model include several interaction variables where broadband speeds and allowances available to firms interacted with technological (in manufacturing) and knowledge (in services) intensity of sectors on the one hand, and location of firms (in urban vs. rural areas) on the other hand. The interpretation of findings follows the conventional practice. The dependent variable and all non-categorical variables with positive values enter the model in a logarithmic form. For this reason, their interpretation is provided in percentage terms. The magnitude of the effect on categorical variables is obtained as an exponential value of the obtained coefficient. Finally, the magnitude of effects yielded through the inclusion of interaction terms is obtained as the exponential value of sum of obtained values on coefficients of interacted variables and interacted term.

Table 2c. Impact of digitalization on firm performance and employment

Sector	Manufacturing			Services		
Variables	Productivity	Sales	Employment	Productivity	Sales	Employment
Capital (ln)	0.04***	0.17***	0.13***	0.06***	0.25***	0.19***
Labor costs (ln)	-0.95***	-0.76***	0.18***	-0.95***	-0.84***	0.11***
Material costs (ln)	-0.04***	-0.05***	-0.004	-0.09***	-0.13***	-0.03***
Localization externalities (ln)	-0.02***	-0.02**	0.01	-0.001	-0.06***	-0.06***
Urbanization externalities (ln)	0.01***	-0.03***	-0.04***	0.05***	0.05***	0.001
Foreign ownership	-0.05***	-0.42***	-0.37***	-0.08***	-0.32***	-0.23***
Location (urban/rural)	-0.04***	0.03	0.06***	-0.10***	-0.08***	0.02***
Digitalization index (ln)	2.12***	3.28***	1.16*	0.67***	0.91***	0.24
R^2 (overall)	0.76	0.31	0.13	0.77	0.45	0.18
F-test	5331***	773***	248***	23131***	5671***	1526***

Notes: ***, ** and * denote statistical significance at a 1%, 5%, and 10% level of significance; country, year, and sector technological/knowledge intensity dummy variables used.
Source: Authors' calculations.

Table 3c. Impact of digitalization components on firm performance and employment

Sector	Manufacturing			Services		
Independent/Dependent variables	Productivity	Sales	Employment	Productivity	Sales	Employment
Capital (ln)	0.04***	0.19***	0.16***	0.06***	0.26***	0.20***
Labor costs (ln)	-0.95***	-0.78	0.17***	-0.94***	-0.85***	0.09***
Material costs (ln)	-0.05***	-0.09***	-0.04***	-0.09***	-0.16***	-0.06***
Localization externalities (ln)	-0.02***	0.01	0.03***	-0.002	-0.05***	-0.05***
Urbanization externalities (ln)	0.01***	-0.01*	-0.03***	0.05***	0.05***	0.002
Foreign ownership	-0.05***	-0.45***	-0.39***	-0.10***	-0.33***	-0.23***
Location (urban/rural)	-0.04***	0.05**	0.09***	-0.09***	-0.06***	0.03***
Broadband speed (> 10 mbit/s)	0.40***	1.33***	0.92***	0.22***	0.53***	0.31***
International bandwidth (ln)	0.13***	0.95***	0.83***	0.10***	0.39***	0.30***
User allowance	0.16***	0.84***	0.68***	0.09***	0.27***	0.18***
Monthly costs of broadband (ln)	0.06	1.44***	1.37***	-0.03	0.59***	0.63***
Penetration rate of broadband (ln)	0.14**	0.77***	0.63***	-0.0003	-0.02	-0.02
R^2 (overall)	0.78	0.35	0.13	0.78	0.49	0.18
F-test	5578***	832***	239***	23159***	6045***	1386***

Notes: ***, ** and * denote statistical significance at a 1%, 5%, and 10% level of significance; country, year, and sector technological/knowledge intensity dummy variables used.
Source: Authors' calculations.

Findings on control variables remain mostly robust across specifications. There is evidence of a positive effect of capital investment and cost reductions on firm performance and employment. The exception from this is an increase in labor costs that leads to higher employment. This signals that firms use higher wages to attract skilled human capital, which is the key complement for the realization of gains from digitalization. In both sectors, firm performance and employment are higher among domestic-owned firms. It appears that firms in urban areas generate more jobs, but are less productive than their counterparts in less urbanized areas. Finally, among agglomeration externalities, we find partial support for the link among between-industrial (urbanization) economies (e.g. access to infrastructure) and firm performance, which signals low levels of resource sharing practices among the firms in the region.

Table 4c. Digitalization and technology intensity

Sector	Manufacturing			Services		
Independent/Dependent variables	Productiv-ity	Sales	Employ-ment	Productiv-ity	Sales	Employ-ment
Capital (ln)	0.04***	0.19***	0.16***	0.06***	0.26***	0.20***
Labor costs (ln)	-0.95***	-0.78***	0.17***	-0.94***	-0.85***	0.09***
Material costs (ln)	-0.05***	-0.09***	-0.04***	-0.09***	-0.16***	-0.06***
Localization externalities (ln)	-0.02***	0.01	0.03***	-0.002	-0.05***	-0.05***
Urbanization externalities (ln)	0.01***	-0.01*	-0.03***	0.05***	0.05***	0.002
Foreign ownership	-0.06***	-0.45***	-0.39***	-0.10***	-0.33***	-0.23***
Location (urban/rural)	-0.04***	0.05**	0.09***	-0.09***	-0.07***	0.03***
Broadband speed (> 10 mbit/s)	0.41***	1.36***	0.95***	0.20***	0.50***	0.29***
International bandwidth (ln)	0.13***	0.96***	0.83***	0.10***	0.40***	0.30***
User allowance	0.16***	0.85***	0.69***	0.09***	0.30***	0.21***
Monthly costs of broadband (ln)	0.06	1.44***	1.37***	-0.03	0.59***	0.62***
Penetration rate of broadband (ln)	0.14**	0.77***	0.63***	0.001	-0.02	-0.02
Technological intensity (medium low)	0.13***	0.05***	-0.09***			
Technological intensity (medium high)	0.27***	0.43***	0.16***			
Technological intensity (high)	0.38***	0.38***	0.002			
Knowledge intensity of sector				0.07***	-0.05***	-0.12***
Interact (speed*htech intensity)	-0.22***	-0.96***	-0.74***			
Interact (allowance*htech intensity)	-0.06*	-0.25***	-0.19**			
Interact (speed*know intensity)				0.07***	0.17***	0.10***
Interact (allowance*know intensity)				0.01**	-0.07***	-0.08***
R^2 (overall)	0.78	0.35	0.13	0.78	0.49	0.18
F-test	5166***	770***	222***	21308***	5564***	1277***

Notes: ***, ** and * denote statistical significance at a 1%, 5%, and 10% level of significance; country, year, and sector technological/knowledge intensity dummy variables used.
Source: Authors' calculations.

Table 5c. Digital infrastructure and firm location

Sector	Manufacturing			Services		
Independent/Dependent variables	Productivity	Sales	Employment	Productivity	Sales	Employment
Capital (ln)	0.04***	0.16***	0.16***	0.06***	0.20***	0.20***
Labor costs (ln)	-0.95***	0.17***	0.17***	-0.94***	0.09***	0.09***
Material costs (ln)	-0.05***	-0.04***	-0.04***	-0.10***	-0.06***	-0.06***
Localization externalities (ln)	-0.03***	0.03***	0.03***	-0.002	-0.05***	-0.05***
Urbanization externalities (ln)	0.01***	-0.03***	-0.03***	0.05***	0.002	0.002
Foreign ownership	-0.06***	-0.39***	-0.39***	-0.10***	-0.23***	-0.23***
Location (urban/rural)	-0.03***	0.15***	0.15***	-0.10***	0.04***	0.04***
Broadband speed (> 10 mbit/s)	0.44***	1.03***	1.03***	0.16***	0.39***	0.39***
International bandwidth (ln)	0.13***	0.83***	0.83***	0.10***	0.30***	0.30***
User allowance	0.17***	0.78***	0.78***	0.09***	0.19***	0.19***
Monthly costs of broadband (ln)	0.06	1.38***	1.38***	-0.03	0.62***	0.62***
Penetration rate of broadband (ln)	0.14*	0.62***	0.62***	0.00003	-0.02	-0.02
Interact (speed*urban)	-0.05	-0.17**	-0.17**	0.07***	-0.10**	-0.10**
Interact (allowance*urban)	-0.03**	-0.18***	-0.18***	0.001	-0.02	-0.02
R^2 (overall)	0.78	0.35	0.13	0.78	0.49	0.18
F-test	5166***	771***	222***	21308***	5562***	1275***

Note: ***, ** and * denote statistical significance at a 1%, 5%, and 10% level of significance; country, year and sector technological/knowledge intensity dummy variables used.
Source: Authors' calculations.

APPENDIX D. INPUT- OUTPUT MODEL

Input-output analysis is a quantitative macroeconomic analysis that explains interdependences between productive sectors in an economy. The primary goal of input-output analysis is to examine and to interpret the effects of final consumption on output, gross value added, and employment. The statistical-information base of input-output analysis is an input-output table showing flows of goods and services between productive sectors of the economy (Miller & Blair, 2009).

Impact of intersectoral flows of sector i on the total production of each sector in the input-output table is described by the equation:

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

where X_i is the total output of sector i, X_{ij} represents intermediate sales by sector i to sector j, while Y_i represents the final demand for sector i's product. The equation (1) can be written as:

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

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

$$X = AX + Y, \quad (3)$$

where $X = \begin{bmatrix} X_1 \\ \vdots \\ X_n \end{bmatrix}$ is a column vector of outputs, $Y = \begin{bmatrix} Y_1 \\ \vdots \\ Y_n \end{bmatrix}$ is a column vector of final demands and

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

If the matrix $I - A$ is non-singular and a positive definite matrix, where I is an $n \times n$ identity matrix, 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. Equation (4) represents the dependence of the total production on exogenously given final demand of all sectors, while the element α_{ij} of the Leontief inverse matrix represents sector i's output required, directly and indirectly, per one unit of final demand from sector j.

IO analysis quantifies direct, indirect, and included effects of each sector of the economy to the overall economy. Mainly, the final consumption effects on output, gross value added, and employment are estimated via indicators called multipliers. There are two types of multipliers, multipliers type I and multipliers type II, which differ according to the form of the IO model. IO model in which the final consumption is considered as an exogenous variable is used to calculate the direct and indirect effects, and indicators which involve direct and indirect effects are called multipliers type I. Closed IO model is an IO model in which some components of the final consumption, mainly households, are considered as endogenous. In those models, effects are defined as direct, indirect, and induced, and multipliers that involve these effects are called multipliers type II (McLennan, 2006). Some authors argued that multipliers type I underestimate the mentioned effects, because the sector of households is excluded from the calculation, while multipliers type II could overestimate the total effects (Grady & Muller, 1988; Miller & Blair, 2009). The actual impact is generally located in the middle of the interval in which the value of multiplier type I is its lower, and the value of multiplier type II its upper bound.

The key of the calculation of multiplier type I is the Leontief inverse matrix $(I - A)^{-1}$ indicating direct and indirect effects on the production. For the multiplier type II calculation, matrix $(I - \bar{A})^{-1}$ is used, where matrix $\bar{A}$ is obtained by expanding the technology matrix A with one more row, representing the compensation of employees' coefficients, and one more column, representing household consumption coefficients. Elements of matrix $(I - \bar{A})^{-1}$ are indicating direct and indirect effects on the production plus induced effects.

Broadband investments are treated as a vector presenting exogenous final demand (Y) whose elements are values of BB goods and services delivered by direct suppliers of the BB infrastructure. In order to calculate GVA and employment effects, the Leontief inverse matrix $(I - A)^{-1}$ is to be premultiplied with gross value added coefficients (vector v whose element v_i represents a share of value added in the output of the relevant sector or employment coefficients [vector *e* whose element e_i represents labor requirements per unit of output]).

A) Investment costs for a telecommunications infrastructure upgrade

Please, estimate the overall costs of investment in a TYPICAL (or the most common) project on the local market required to ensure availability of internet speed over 50 mbps to the final user. Project should be large enough to be treated as a reference project and represent a typical investment in a local market regarding the structure of users (urban/rural) and the prevailing status of the current telecommunications infrastructure (need to build a new or upgrade the existing infrastructure). For example, investment which ensures an upgrade of internet speed for at least 10,000, including all costs (cables, construction work, costs of central units etc.).

	Please, express the estimates of investment value per line	Please, estimate the share of investment value which could be produced domestically or imported, based on experience and a current list of suppliers			
	Investment value **per line** (total investment in reference project/number of final users), expressed **in euro**	Share of investment component (in percentage of the investment value of a component)			
		Domestic origin (economy where investment is undertaken)	Import from foreign markets	Of which import from WB economies	Please specify a WB economy* from which a component is expected to be supplied
Total investment value per line					
1. Computers, electronic, and optical products, communication equipment					
2. Electrical equipment (el. motors, batteries, optical cables, and wiring)					
3. Other machinery and equipment					
3.1. (please specify the type of other equipment)					
3.2. (please specify the type of other equipment)					
3.3. (please specify the type of other equipment)					
4. Construction work					

5. Transport services					
6. Telecommunications services					
7. Computer programing, informational services					
8. Professional, technical, legal, and other business services					
9. License fees (which could be treated as an investment)					
10. Other investment costs					
10.1. (please specify the type of other costs)					
10.2. (please specify the type of other costs)					

Source: Authors' construction.

MULTIPLIERS FOR THE MOST IMPORTANT SUPPLIERS WITHIN A BROADBAND INVESTMENT

Albania

	CPA Code	CPA_C26	CPA_C27	CPA_F	CPA_J61
	Sector	Computer, electronic, and optical products	Electrical equipment	Constructions	Telecommunications services
Gross output	Direct impact (change of final demand)	1.0000	1.0000	1.0000	1.0000
	Multiplier type I	1.4159	1.4159	1.8225	1.6708
	Multiplier type II	1.8388	1.8388	2.1644	2.0551
Gross value added	Direct effect	0.4413	0.4413	0.3147	0.3212
	Indirect effect	0.1720	0.1720	0.3315	0.3058
	Induced effect	0.2290	0.2290	0.1852	0.2081
	Total effect	0.8424	0.8424	0.8314	0.8352
	Multiplier GVA type I	1.3897	1.3897	2.0534	1.9522
	Multiplier GVA type II	1.9087	1.9087	2.6417	2.6001
Employment induced by 100 Mil. euro of final demand	Direct effect	57.58	57.58	11.02	19.91
	Indirect effect	12.20	12.20	21.62	23.11
	Induced effect	33.05	33.05	26.72	30.03
	Total effect	102.83	102.83	59.36	73.05
	Multiplier em. type I	1.2119	1.2119	2.9609	2.1604
	Multiplier em. type II	1.7859	1.7859	5.3848	3.6684
Import	Direct effect	0.1847	0.1847	0.1187	0.1753
	Indirect effect	0.0602	0.0602	0.1166	0.0919
	Induced effect	0.0448	0.0448	0.0363	0.0407
	Total effect	0.2897	0.2897	0.2715	0.3080
	Multiplier type I	1.3259	1.3259	1.9820	1.5242
	Multiplier type II	1.5687	1.5687	2.2875	1.7565

Source: Authors' calculations.

Croatia

	CPA Code	CPA_C26	CPA_C27	CPA_F	CPA_J61
	Sector	Computer, electronic, and optical products	Electrical equipment	Construction	Telecommunications services
Gross output	Direct impact (change of final demand)	1.0000	1.0000	1.0000	1.0000
	Multiplier type I	1.6474	1.6790	1.8500	1.6508
	Multiplier type II	2.2431	2.2353	2.4892	2.1050
Gross value added	Direct effect	0.3372	0.2982	0.3816	0.5549
	Indirect effect	0.2803	0.2896	0.3647	0.3305
	Induced effect	0.3118	0.2912	0.3346	0.2378
	Total effect	0.9293	0.8789	1.0808	1.1231
	Multiplier GVA type I	1.8311	1.9711	1.9557	1.5957
	Multiplier GVA type II	2.7559	2.9477	2.8326	2.0242
Employment induced by 100 Mil. euro of final demand	Direct effect	11.37	13.16	19.51	4.72
	Indirect effect	10.58	11.10	14.49	8.45
	Induced effect	11.03	10.30	11.84	8.41
	Total effect	32.98	34.56	45.84	21.58
	Multiplier em. type I	1.9302	1.8435	1.7426	2.7897
	Multiplier em. type II	2.9003	2.6264	2.3492	4.5715
Import	Direct effect	0.2766	0.2977	0.1093	0.0427
	Indirect effect	0.0989	0.1071	0.1124	0.0613
	Induced effect	0.0630	0.0588	0.0676	0.0480
	Total effect	0.4385	0.4636	0.2893	0.1520
	Multiplier type I	1.3578	1.3599	2.0282	2.4352
	Multiplier type II	1.5854	1.5575	2.6462	3.5590

Source: Authors' calculations.

The Former Yugoslav Republic of Macedonia

	CPA Code	CPA_C26	CPA_C27	CPA_F	CPA_J61
	Sector	Computer, electronic, and optical products	Electrical equipment	Construction	Telecommunications services
Gross output	Direct impact (change of final demand)	1.0000	1.0000	1.0000	1.0000
	Multiplier type I	1.2624	1.2003	1.5086	1.4425
	Multiplier type II	1.5373	1.4426	1.8155	1.7213
Gross value added	Direct effect	0.2646	0.1986	0.3975	0.5993
	Indirect effect	0.1335	0.0970	0.2194	0.2178
	Induced effect	0.1468	0.1295	0.1640	0.1489
	Total effect	0.5450	0.4250	0.7809	0.9660
	Multiplier GVA type I	1.5046	1.4883	1.5520	1.3633
	Multiplier GVA type II	2.0595	2.1404	1.9645	1.6119
Employment induced by 100 Mil euro of final demand	Direct effect	31.26	34.07	37.35	8.15
	Indirect effect	9.56	6.61	13.68	17.46
	Induced effect	12.28	10.83	13.72	12.46
	Total effect	53.11	51.52	64.75	38.08
	Multiplier em. type I	1.6249	1.5911	2.4085	1.8493
	Multiplier em. type II	2.3989	2.1938	3.3032	2.3269
Import	Direct effect	0.5495	0.6341	0.2375	0.0974
	Indirect effect	0.0484	0.0412	0.1167	0.0766
	Induced effect	0.0456	0.0402	0.0509	0.0463
	Total effect	0.6436	0.7155	0.4051	0.2203
	Multiplier type I	1.0881	1.0650	1.4916	1.7861
	Multiplier type II	1.1711	1.1284	1.7060	2.2609

Source: Authors' calculations.

Slovenia

	CPA Code	CPA_C26	CPA_C27	CPA_F	CPA_J61
	Sector	Computer, electronic, and optical products	Electrical equipment	Construction	Telecommunications services
Gross output	Direct impact (change of final demand)	1.0000	1.0000	1.0000	1.0000
	Multiplier type I	1.5952	1.5057	2.1750	1.8523
	Multiplier type II	2.2586	1.9510	2.7610	2.2844
Gross value added	Direct effect	0.3864	0.2596	0.2728	0.3876
	Indirect effect	0.2677	0.2231	0.4049	0.3910
	Induced effect	0.3515	0.2360	0.3105	0.2290
	Total effect	1.0055	0.7187	0.9881	1.0076
	Multiplier GVA type I	1.6928	1.8593	2.4843	2.0087
	Multiplier GVA type II	2.6025	2.7682	3.6226	2.5995
Employment induced by 100 Mil. euro of final demand	Direct effect	11.68	10.07	8.93	12.33
	Indirect effect	7.30	5.95	12.57	10.48
	Induced effect	9.04	6.07	7.99	5.89
	Total effect	28.02	22.09	29.48	28.70
	Multiplier em. type I	1.6249	1.5911	2.4085	1.8493
	Multiplier emtype II	2.3989	2.1938	3.3032	2.3269
Import	Direct effect	0.2386	0.4190	0.1200	0.1212
	Indirect effect	0.1041	0.0909	0.1773	0.0945
	Induced effect	0.0787	0.0529	0.0696	0.0513
	Total effect	0.4214	0.5628	0.3668	0.2670
	Multiplier type I	1.4362	1.2169	2.4773	1.7802
	Multiplier type II	1.7663	1.3430	3.0571	2.2036

Source: Authors’ calculations.

Table 1d. Approximate values of investments per final user, in euro

	Investments 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)	Stratified sample including total territory
Croatia	380	Brownfield (copper)	Stratified sample including total territory
The Former Yugoslav Republic of 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	Stratified sample including total territory
Serbia	2500	Mobile	Stratified sample including total territory

Source: Western Balkan telecommunication companies survey (authors' construction).

Table 2d. Effects of 100 million euro broadband investments

	Albania	Bosnia and Herzegovina	Croatia	The Former Yugoslav Republic of 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**
				Gross value added, 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.

ECONOMIC BENEFITS OF TOTAL BROADBAND INVESTMENTS REQUIRED TO REACH STRATEGIC GOALS – THE CASE OF CROATIA

In 2012, the Ministry of the Sea, Transport and Infrastructure of the Republic of Croatia ordered a study with the aim of analyzing all geographical, demographic, and infrastructural factors in the total national territory, in order to estimate the total costs of broadband infrastructure development and propose appropriate programs and financing models. Methods applied and the results obtained are officially available in the document "The choice of the most favorable financial models and investment incentives for the development of the broadband infrastructure" (MMPI, 2012). Total investments that are required to reach strategic goals on general availability of broadband services on the total Croatian territory are estimated at 12 billion kuna (approximately 1.6 billion euro). The majority of investments are to be oriented to cover “white” and improve “grey” areas, but certain costs are required in “black” spots. Because of the high costs of some infrastructural programs, it is estimated that investments are to be provided by public funds, reaching approximately 1 billion euro. As those estimates are benchmarked on 2012 prices, total costs at current prices could be even higher. However, Table A is based on those officially available data in order to illustrate total potential of broadband investments in Croatia. "Croatian Strategy for Broadband Development in the Republic of Croatia for 2016–2020" (Official Gazette, no. 68, 2016) presents indicative distribution of public funds for the financing of a BB infrastructure for the seven-year period 2017–2023. Table A therefore estimates total cumulative effects of 1.6 billion euro investments and average annual effects. Development of the broadband infrastructure could provide a strong stimulus to the Croatian economic activity, and just through investment, demand channel could contribute to an additional economic growth of 0.58 percent on an annual basis, proving an opportunity for nine thousand individuals annually to be directly or indirectly employed in infrastructure development.

Table 3d: Estimate of the economic effects of total BB investment required to reach the strategic goals, values for output and GVA expressed in thousand euro

	Output	GVA	Employment
Direct	1,600,000	532,227	24,660
Indirect	1,169,938	501,362	19,440
Induced	944,062	494,168	17,481
Total	**3,714,000**	**1,527,757**	**61,581**
Annual effects (average of a seven-year period)	530,571	218,251	8,797
Average annual effects, in %	**0.57**	**0.58**	**0.55**

Source: Authors’ calculations.

APPENDIX E. INDEX OF ECONOMIC COOPERATION AND DIGITAL TRANSFORMATION CONVERGENCE

In order to measure the extent of economic cooperation between the economies in the region, we use an index of economic cooperation. The calculation of the index is based on Broz, Buturac and Tkalec (2015). However, unlike their index, which measures the economic cooperation between Croatia and the economies in the region, we measure the cooperation between all economies in the region.[72] Economic cooperation includes regional foreign trade, foreign direct investment (FDI), and tourism. By using these three fields of cooperation, we are able to analyze trends in economic cooperation between the economies in the region.

In order to construct the index of economic cooperation, it is first necessary to calculate cooperation indices (CI) for individual fields (foreign trade, FDI, and tourism), which are then integrated into the harmonized index of economic cooperation, with the weight of each cooperation index proportional to its monetary share in total cooperation.

For the calculation of the cooperation index in the field of foreign trade, we use the sum of the values of exports to and imports from an individual economy in the region to the other economy in the region in a respective year. Then the trade from all economy pairs are added together to come up with the total regional trade in a respective year. Similar procedure is followed for the other fields: for foreign direct investments, we use the sum of all FDI inflows from one economy in the region to the other economy in the region, and for tourism we use the sum of all arrivals of tourists from one economy in the region to the other economy in the region. The individual CI design and calculation are given by the following formula, which basically represents the base index[73]:

$$CI_t = \frac{y_t}{y_b} * 100, t = 2005,\ldots, 2017, (1)$$

where y_t represents the monetary value of regional trade and foreign direct investment, as well as tourist arrivals in year t, while y_b denotes the corresponding value in the base year (2005). Data for foreign trade and FDIs are expressed in euro, while the data for tourism is expressed in the number of

[72] Economies in the region include Albania, Bosnia and Herzegovina, Croatia, The Former Yugoslav Republic of Macedonia, Kosovo*, Montenegro, Serbia, and Slovenia.

[73] Public data are available until 2016. However, in order to gain more insights in the regional developments, we estimated data for 2017 using GDP projections (for foreign trade and tourism) and projection of the FDI inflows in transitional economies. Projections for the GDP are taken from the IMF database, and for FDI inflows from the UNCTAD (2016a). Also, for some economy pairs the data at the beginning of the sample are missing, hence this data are estimated with the average growth rates in the remaining period. Data for Kosovo* are missing for the foreign trade.

tourist arrivals. The increase in the indices represents the increase in regional cooperation.

For the purpose of calculating the harmonized index of economic cooperation (IEC), which includes all fields, we need to construct weights for each specific field. Ideally, in order to construct weights, we should have monetary values for all variables. However, since the data for regional earnings from tourism are not available, we had to estimate it from the total earnings from tourism using regional tourist arrivals. First, we calculate the share of regional tourists in all tourist arrivals, and then we multiply this share with the total earnings from tourism for all economies, which gives us the estimate of regional earnings from tourism.[74] After we have obtained all three monetary values, we are able to calculate the weights of the individual categories of economic cooperation:

$$w_{it} = \frac{m_{it}}{\sum_{i=1}^{3} m_{it}}, i = 1, 2, 3; t = 2005, \ldots, 2017, \qquad (2)$$

where m_{it} stands for monetary values of regional trade, foreign direct investments, and tourism. The sum of all three weights is 1.

The index of economic cooperation is then calculated as follows:

$$IEC_t = \sum_{i=1}^{3} CI_{it} * w_{it},\ t = 2005, \ldots, 2017. \qquad (3)$$

In other words, we weighted the developments in the individual cooperation indices with their share in total regional economic cooperation. Again, the increase in the index represents the increase in the regional economic cooperation.

DIGITAL TRANSFORMATION CONVERGENCE

In order to measure digital transformation convergence, we use the coefficient of variation[75] of proxies for digital transformation for individual economies:

$$CV_t = \frac{\sigma_t}{\mu_t} * 100, t = 2005, \ldots, 2016, \qquad (4)$$

where σ_t stands for the standard deviation, and μ_t for the average of a variable that represents digital transformation of the economies in the region. Data for proxies for digital transformation are taken

[74] The calculations are made under the assumption that tourists from all economies on average spend the same amount of money on tourist visits in the analysed economies in the region. However, economies in the region have lower GDP per capita than Western European countries, and hence it is expected that tourists from the region spend less than tourist from the Western Europe, which means that we overestimated the total regional earnings from tourism. However, since tourists from the region represent on average 19 percent of all tourist arrivals in the region and tourists from the region together with other tourists from South-eastern and Eastern Europe represent majority of tourist arrivals in most economies of the region, the bias should be negligible.
[75] Coefficient of variation is a statistical measure that shows the extent of variability in relation to the mean of the variable. It is used when there are large differences in means (over time), which is the case in our dataset.

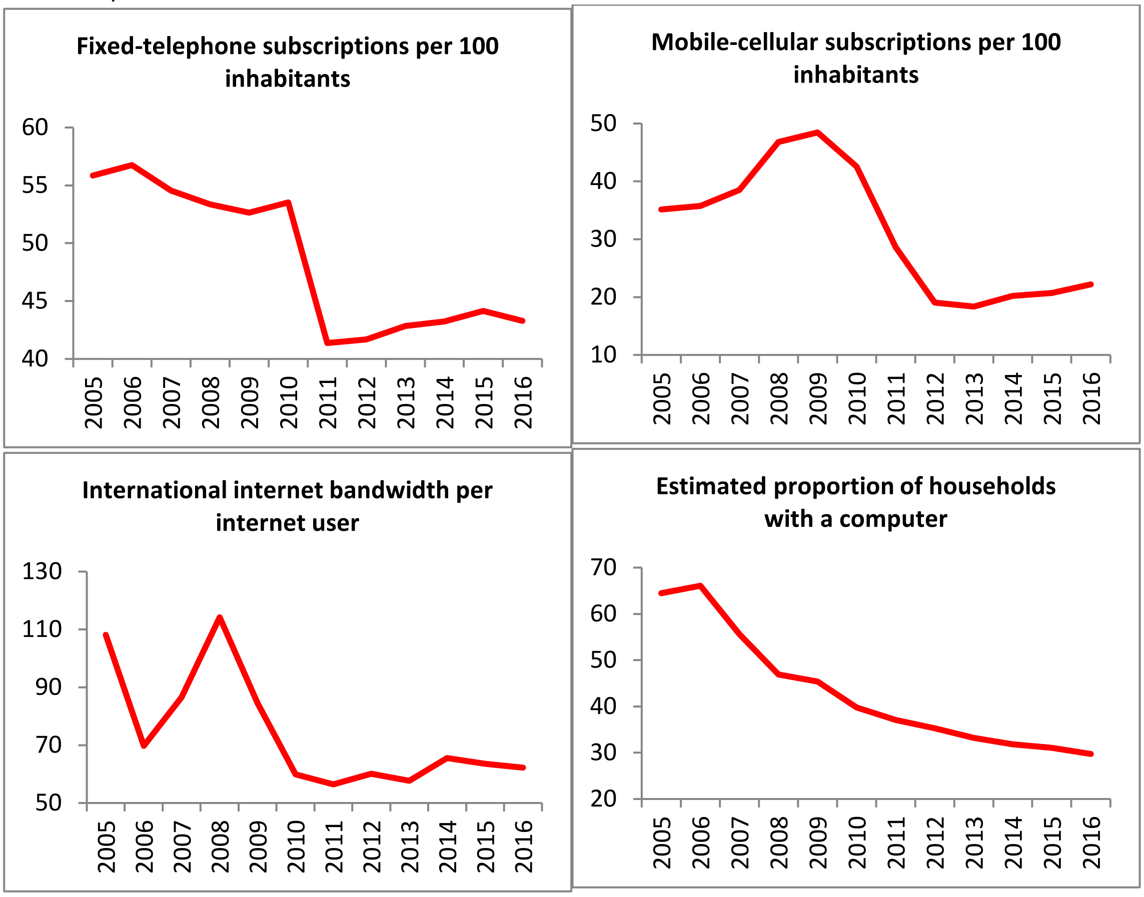
from the WT/ICT database. We calculate the coefficient of variation separately for every year across the economies in the sample for every variable. The decrease in the coefficient of variation through time implies that the variation between the economies in the region is reduced. In other words, the decrease implies that the degree of digital convergence between the economies in the region has increased.

Since we are using several different variables for digital convergence, in order to come up with a single measure of convergence, we constructed a weighted digital convergence indicator. For parsimony, weights are the same for all individual variables (since we have eight variables, the weight equals 0.125). The weighted digital convergence indicator is then calculated as:

$$DCI_t = w_i * CV_{it}, t = 2005, \dots, 2016, \qquad (5)$$

where CV_{it} stands for the coefficient of variation of different digitalization variables. Again, the decrease implies that the degree of digital convergence between the economies in the region has increased.

Figure 1e. Digital transformation convergence – individual indicators (measured by the coefficient of variation)



Notes: Scale is in %; 0 indicates complete convergence; the larger the coefficient of variation, the larger the divergence between Western Balkan economies in a given year.
Source: Authors' calculations.