



Artificial Intelligence in Bosnia and Herzegovina: Contextual Analysis

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Abstract

This paper reviews the effects of artificial intelligence on economic growth and innovation using white and grey sources from 2018 to 2024. Special consideration is given to the future of AI in the Republic of Bosnia and Herzegovina, a Western Balkan country. A three-step content analysis was employed. First, content identification was performed using IEEE, Scopus, and Web of Science along with an interdisciplinary framework. Second, the scholarly articles were compared and contrasted against the AI Index, the Global Innovation Index, the Government AI Readiness Index, and investment climate reports for the same time period. Third, the content was coded; themes and trends were identified. The content analysis portrays a country in transition. The paper argues that transitional economies can experience AI driven growth. The results show that while awareness of artificial intelligence is growing and indications of potential are present, peers Serbia and North Macedonia outperform the Republic of Bosnia and Herzegovina in readiness to implement artificial intelligence. The analysis reveals that the country's potential is hindered by emigration, insufficient capital and institutions, and lack of vision on advanced technologies. Consequently, it is recommended that the country implement reforms that increase investment and encourage entrepreneurship.

Keywords: AI; Indicators; Innovation; Western Balkan Economies

1. Introduction

Bosnia and Herzegovina is one of the poorest countries in Europe. The fall of Yugoslavia established the Dayton Agreement. The war and the resulting agreement led to a division within the country, and the Western Balkans. It began an era of high ethnic tensions, dysfunctional governance, long decision-making, delayed reforms, and protection of non competitive sectors.

Despite having been through war, the turbulence and restructuring of the region, the people are resilient. While progress in digital infrastructure, innovation and education remains low, sectors such as agriculture have been re cultivated. Therein lies the paradox.

While Bosnia and Herzegovina is working towards digital transformation, the talent is moving abroad.

The economy is stagnant at a time when sense of urgency is more than a trite saying. It is about survival of a country's dream for economic growth and competitiveness. The unpredictability has resulted in less than ideal foreign direct investment and difficulties expanding its industrial base.

This raises an important question: could artificial intelligence be the push Bosnia and Herzegovina needs to prompt an economic evolution?.

1.1 Literature Review

To understand the implications of artificial intelligence, it is important to consider the insight from global thought leaders. This is especially true for transitioning economies, such as Bosnia and Herzegovina. Research is limited in the Western Balkans and the state of the economy dictates policy choices must be intentional. The examination of sources by leading economists revealed implications of artificial intelligence in the areas of finance, economic growth, inequality, and employment.

Authors Brynjolfsson and Unger discussed how a favorable AI future would be the result of sound policy decisions today (Brynjolfsson & Unger, 2023). Their article focused in on three key areas: productivity growth, income inequality, and industrial concentration. The three key areas were represented with two choices, each accompanied by descriptions and impacts when artificial intelligence was introduced. The favorable impact included supplementing and adding value for the employees, whereas the unfavorable impact to the workforce resulted in employees being replaced by artificial intelligence. Consistent with trends in the research, the authors also discussed large companies from advanced economies tend to be the early adopters due to the substantial costs involved.

Authors Acemoglu and Johnson indicated that intention is critical when adopting artificial intelligence in the workplace (Acemoglu & Johnson, 2023). The authors advocated for the adoption of a five principle approach by decision makers when entering into artificial intelligence development. This approach is important as artificial intelligence can serve as a complement or a substitute and impact employment and inequality or foster inclusive growth. The principles require the insertion of tax codes, research and development, regulations, and governance. The principles are relevant for developing countries, particularly for women and the service sector. The trends shows a displacement risk for women and an underrepresentation in artificial intelligence outputs.

Author Gopinath recommended publicly funded research and global governance to ensure the world has access to the remarkable benefits while managing the risks properly (Gopinath, 2023). This perspective complements the analysis by Acemoglu and Brynjolfsson. The author emphasizes a human approach and responsible progress. A key area of discussion is the enhancement of productivity (Lane et al., 2023), highlighting the experience of emerging countries Brazil and South Africa (Gopinath, 2023). Modest productivity gains in emerging economies is a trend in the research. The gains are associated with differences in structural sectors between emerging and developed economies.

Finally, authors Nilekani and Bhojwani discussed the path India, an emerging economy, took to advance its economic status and social future (Nilekani & Bhojwani, 2023). While some countries are waiting on other countries to be the trailblazers, India utilized artificial intelligence to solve certain societal problems. For example, by addressing the critical and immediate needs of people for rickshaw ride sharing, the country supported the development of an app. The country also invested in the technology to aid farmers in financial applications

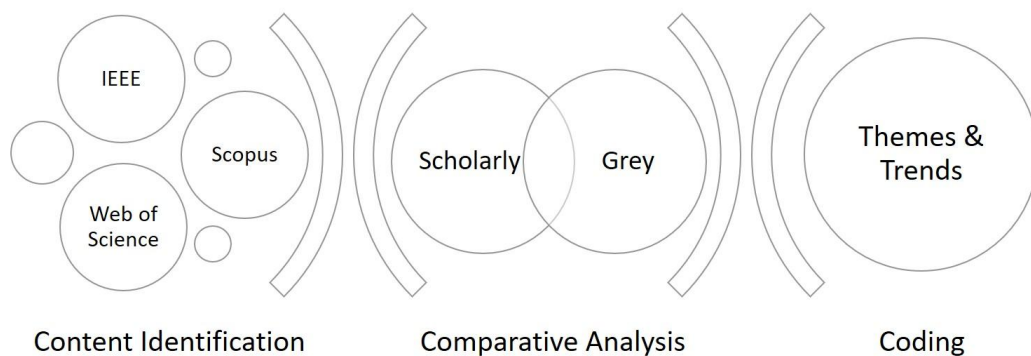
and payment for agricultural products and services. Trends in the broader research on the diffusion of artificial intelligence in transitioning economies shows the gap between low and middle income countries is decreasing. The improvement is likely the result of investment in global value chains, international research and knowledge transfers.

The paper is organized in sections. The first section introduced the reader to a transitioning economy, Bosnia and Herzegovina. Literature on artificial intelligence from thought leaders was presented. Section 2 makes an argument in support of content analysis when researching countries with limited quantitative data. The research results are presented in Section 3. Section 4 includes a discussion of the recurring economic issues. Finally, support for a knowledge-based economy is recommended through future research in section 5.

2. Methods

Content analysis was combined with a literature review to explore the research question: *What is the future of artificial intelligence in Bosnia and Herzegovina?* This method was chosen for its value in researching emerging economies where quantitative data is limited but discussions and planning around advanced technologies are evolving. Figure 1 illustrates the three step method.

Figure 1: Content Analysis Method



Source: Author's Contribution

The first step included literature from IEEE and Scopus databases, as well as the Web of Science platform. The period for content identification was 2018 to 2024. The results on artificial intelligence in English were voluminous, depicting a rapid increase in interest in the field. For the comparative analysis step, data from the AI Index Reports, the Global Innovation Index, and the Government Artificial Intelligence Readiness Index were included. These indices were important for observing the differences in the levels of investment, research, and workforce development, as well as the economic and legal environment to support it. In the final step, the content was coded, allowing for the identification of several themes and trends. Microsoft Excel was used for the coding effort. Codes included: AI & Macroeconomics, AI & Digital Transformation, AI & Western Balkans, AI & Global Economy, AI & Workplace Impact, AI & Innovation Research, AI Development Investment and AI Readiness & Implementation. The codes were broken down by Innovation, Investment and Regulatory indicators. From this, the themes and trends were identified. These included tensions or stressors with economic impacts such as Potential vs.

Preparedness, Brain Drain and the Digital Paradox and Innovation without Infrastructure. An important limitation of this method is that it was less helpful in understanding complexities unique to the Western Balkans, particularly Bosnia and Herzegovina. This method may also be subject to coding errors, content restrictions, and overgeneralizations. To address these limitations, government, industry, and international economic publications were analyzed over a six-year period. The publications included Artificial Intelligence Papers, European Commission Staff Working Documents, Finance and Development magazine, and Investment Climate Statements. The results were compared with economic indicators.

3. Results

The results indicate the Western Balkans have more potential than readiness for artificial intelligence. Table 1 shows that progress is country-specific rather than regional. Serbia is in the leading position. Serbia secured a €100 million investment, will chair an international committee, and has advanced infrastructure (NALED, 2018, Russo et al., 2023). In contrast, Bosnia and Herzegovina is in last position. This is evidenced by limited collaboration and underdeveloped infrastructure. Albania and North Macedonia fall in the middle. Both countries are growing their startup scenes and investing in education.

Table 1: Artificial Intelligence in the Western Balkans

Area	Albania	Bosnia and Herzegovina	North Macedonia	Serbia
Collaboration	Limited	Minimal	Limited	Advanced
Commitment	Early Development	Early Development	Developing	Advanced
Education & Innovation	Universities and Startups; AI Education and Research	Universities; AI Knowledge Sharing and Research	Skills Training	Strong Initiatives e.g. S4AI_HUB
Infrastructure	Early Development	Underdeveloped	Developing	Advanced
Investment	EU Funding	Limited	World Bank Funding	€100M by 2026
Startups	Growing	Emerging	Growing	Active

Source: Author's Contribution

3.1 Innovation Indicators

Bosnia and Herzegovina underperforms globally in innovation capacity. Comparing artificial intelligence use by region and global innovation rankings, a ranking of 80 in 2024 places the country below the rest of the Western Balkans (WIPO, 2024). The Global Innovation Index, which tracks the major pillars of technology development among countries, shows this marks a decline from 77 in 2018. The country's best performance was a ranking of 70 in 2022 (WIPO, 2022). The trend is a decline in the rankings over the past six years. According to the indices, peers Serbia and North Macedonia have stronger innovation ecosystems. Certainly, these rankings do not paint a favorable artificial intelligence driven growth picture.

Yet, the country has positive rankings. Domestic industry diversification is increasing, government funding for education scores is improving and knowledge diffusion is a strength. Despite this, the limited funding of research and development and lack of political commitment to artificial intelligence has created the perception of an unattractive country with low innovation outputs (European Commission, 2024B; U.S. Department of State, 2024). Specific rankings for Bosnia and Herzegovina for the time frame between

2018 and 2024 are not readily available in the AI Index, which provides specific and general trend analysis within government, industry and society.

3.2 Investment Indicators

Bosnia and Herzegovina struggles with funding and attracting financing to support artificial intelligence. The sources portrays a country with fragmented funding and political environments (U.S. Department of State, 2024). This has affected investor confidence.

In 2024, the country's nominal gross domestic product was estimated at €26.4 billion (International Monetary Fund, 2024). Gross investment was estimated at 27% of the gross domestic product. This is a minimal increase from 2023. However, research and development expenditure is low and approximately 48% of the funding is spent in manufacturing (European Commission, 2023; European Commission, 2024B; U.S. Department of State, 2024).

Foreign direct investment increased temporarily between 2022 and 2023, but was low and economic growth flat in 2024 (European Commission, 2024A; European Commission, 2024B; U.S. Department of State, 2024). Foreign direct investment continues to be significant in manufacturing though software and outsourcing are growing (European Commission, 2023; U.S. Department of State, 2024).

The protection of uncompetitive sectors and slow adoption of technology persist. . This has resulted in inefficiencies, lack of improvements in productivity, bureaucracy and a weak regulatory environment. For instance, assets held by public companies in Bosnia and Herzegovina is estimated at 100% of gross domestic product GDP (European Commission, 2024A).

Finally, the country continues to be challenged with human capital, a determinant of foreign direct investment. The country's high emigration rate includes an inordinate number of researchers (European Commission, 2024B). Emigration reduces the labor supply and affects investment demand.

3.3 Regulatory Indicators

The legal and regulatory environment in Bosnia and Herzegovina is insufficient for artificial intelligence. While the 2024 Government AI Readiness Index shows Eastern Europe outperformed the global average, ranking fourth, the index also indicates a decline from third position in 2023 (Oxford Insights, 2023-2024). Bosnia and Herzegovina underperformed within the region each year from 2019 to 2024 (Oxford Insights, 2019-2024). The country appears to have reversed course from 2021 to 2024 in two of the three pillars: Government, and Data and Infrastructure (Oxford Insights, 2021-2024). In 2021, the country scored 31.05 in the Government pillar (Oxford Insights, 2021). The Government pillar includes gauges for governance and ethics, vision, and government support for artificial intelligence. In 2024, the country scored 26.74, 4.31 points lower (Oxford Insights, 2024). The change may be due to failure to act on the recommendations made by the European Union (European Commission, 2023; U.S. Department of State, 2024). The country is in early integration with the *acquis*. As a result, improvements are still to be made to the essential regulatory environment, including adopting a national strategy.

4. Discussion

The findings suggest Bosnia and Herzegovina is grappling with four economically impactful issues:

First, the country has greater potential than readiness for artificial intelligence. An emphasis on STEM education and the resulting focus on digital transformation is in its favor. Digital transformation has been shown to positively influence economic growth in developing countries (Aly, 2020). In the Western Balkans, the level of digital skills correlates with gross domestic product (Levkov & Kitanovikj, 2024). Adversely impacting progress toward readiness are limited funding, underdeveloped institutions, and emigration (European Commission, 2024A; European Commission, 2024B; U.S. Department of State, 2024).

Second, the emigration of skilled labor lowers the country's ability to develop competitive industries and innovate. The research highlights a low level of research development. A national artificial intelligence plan that embodies qualified research completed globally, could help the country focus their innovation research efforts and use their funds more wisely (Mariana et al., 2023).

Third, the country's slow pace of digital transformation impedes progress with artificial intelligence. Policymakers should be cognizant that to scale artificial intelligence, digital transformation needs to be accelerated and skilled labor retained. Europe is already lagging in this divide when compared to global competitors (Straus, 2020). Multiple stakeholders are needed to design policies that ultimately comply with data privacy regulations (Krivokapić et al., 2022).

Fourth, Bosnia and Herzegovina has innovation without the appropriate support systems. Long term sustainability is questionable without the key interdependencies of an enforced legal environment and financial support.

5. Conclusion

There is momentum in artificial intelligence in the Western Balkans. Transitioning economies could shift from turgid bureaucracy to agile e-governance and from growth-stifling public sectors to supporters of innovation. This raises an important question: could artificial intelligence be the push Bosnia and Herzegovina needs to prompt an economic evolution?

The findings show stagnation and inefficiencies are present. However, if more contemporary and forward thinking strategies were employed, the future holds promise for Bosnia and Herzegovina. The path must be paved with government buy in and capital investment in education and entrepreneurship.

From a practical standpoint, artificial intelligence can improve transparency, streamline public services and reduce administrative costs. The benefit of which is investment by the diaspora community and retention of skilled workers. Furthermore, high value jobs could be created.

To support the transformation in Bosnia and Herzegovina, two future areas of research are recommended. The first study should identify strategies Serbia used to secure funding to support and sustain its digital infrastructure. Bosnia and Herzegovina may be able to duplicate the models. The second study should be about emigration to support a knowledge-based economy, with a focus on talent portability.

Artificial intelligence alone is not an end all for Bosnia and Herzegovina's economic issues. The value added is the opportunity to invest, reform, and govern by implementing the recommendations. In addition to modernizing the economy, this recommendation has the potential to improve regional competitiveness and build public trust in institutions.

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