FROM BYTES TO JOBS: DECODING BOSNIA AND HERZEGOVINA'S EMPLOYMENT PUZZLE THROUGH FDI AND ICT

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Abstract

Bosnia and Herzegovina's transition from socialism to capitalism has led to fundamental changes in the country's economic structure, with unemployment, FDI, economic growth, and information technologies becoming critical factors in this process. Information and Communication Technology (ICT) and Foreign Direct Investment (FDI) can promote economic growth and generate employment, helping to tackle unemployment through various channels. Bosnia and Herzegovina has been facing long-term unemployment for years. Thus, this study uses an Autoregressive Distributed Lag (ARDL) bounds testing approach and structural break technique to explore the impact of FDI, ICT, and growth on unemployment in Bosnia and Herzegovina for the period 1997–2022. The research findings indicate that FDI has a negative impact on unemployment in the long run. On the other hand, ICT has a positive impact on unemployment in the long run. Moreover, empirical findings demonstrated that there is a negative and significant relationship

between growth and unemployment in the long run. This implies the validity of Okun's Law for Bosnia and Herzegovina. Furthermore, the study brings forth a crucial insight that the impacts of FDI on unemployment are not uniform and differ significantly based on the type of FDI inflows.

Keywords: unemployment, FDI, ICT, economic growth, Bosnia & Herzegovina.
JEL Classification: C22, J64, O11

1. INTRODUCTION

Bosnia and Herzegovina, as a Balkan country, witnessed the most significant devastation, corruption, and ethnic conflict in post-World War II Europe, resulting in severe consequences for the nation. The war, which led to the deaths of millions, left the country with deep wounds [Yazıcı, 2018: 96]. In the 1980s, Bosnia and Herzegovina (BiH) was one of the most dynamic republics within the former Socialist Federal Republic of Yugoslavia. However, following the declaration of independence in April 1992, the country plunged into a devastating war that lasted until November 1995. This conflict caused the displacement of approximately 1.2 million people and resulted in widespread physical and economic destruction. The current political structure of Bosnia and Herzegovina was established through the General Framework Agreement for Peace, which ended the war [Bartlett et al., 2012: 202].

During its time as part of the Socialist Federal Republic of Yugoslavia, Bosnia and Herzegovina operated under a socialist economic model characterized by central planning, state control over the economy, and worker cooperatives, which were the primary determinants of production processes. However, by the late 1980s, the economic crisis that plagued Yugoslavia rendered the socialist structure unsustainable. Political turmoil and the dissolution of Yugoslavia in the early 1990s led to Bosnia and Herzegovina's descent into the Bosnian War from 1992 to 1995. The war decimated the country's economic infrastructure and plunged the economy into a severe collapse. With the end of the war and the signing of the Dayton Agreement in 1995, Bosnia and Herzegovina's political and economic framework was fundamentally reshaped. Following the Dayton Agreement, the country made efforts to rapidly adapt to a capitalist economy. Economic recovery and transformation were recognized as essential to the success of the Dayton process and the survival of the Bosnian state. However, the original privatization timeline in Bosnia implied that privatization was to be completed before the broader economic reforms and institutional rebuilding had even fully commenced [Donais, 2002: 3–5].

While peace was established in 1995 following the Dayton Agreement, Bosnia and Herzegovina faced significant challenges in transitioning from a socialist system to a capitalist market economy. During this period, privatization, the promotion of foreign direct investment (FDI), and free market reforms were implemented. However, the complexity of the transition, combined with the economic and social issues resulting from the post-war destruction, limited the effectiveness of these reforms. Bosnia and Herzegovina encountered high unemployment rates during its transition from socialism to capitalism. In 1996, unemployment in the Federation of Bosnia and Herzegovina was estimated at 50 %. The Bosnian population continues to suffer from severe economic problems, with an unemployment rate of 20.5 % and 17.2 % of the population living below the poverty line [Sancaktar, 2018: 216].

The closure of many state-controlled enterprises during privatization and the limited availability of new job opportunities were among the primary causes of unemployment. When examining the unemployment rates in Bosnia and Herzegovina from 1991 to the present, the highest rate was recorded in 2006, at 31.1 %. In the past five years, the unemployment rate has gradually decreased, reaching 15.7 % in 2019, 15.9 % in 2020, 14.9 % in 2021, 12.7 % in 2022, and 11.8 % in 2023 [World Bank, 2024].

Foreign direct investment (FDI) has been pivotal in Bosnia and Herzegovina's post-war rebuilding and economic recovery. Particularly in sectors such as energy, construction, and banking, foreign investments have accelerated economic growth and increased job creation potential in some regions. Although FDI began arriving in the early 2000s, its volume has not been particularly high. Between May 1994 and 2018, the total FDI inflow to the country amounted to approximately 7.31 billion EUR [Ministry of Commerce, 2022]. In 2020, FDI inflows amounted to 421 million EUR. Revised data from the Central Bank of Bosnia and Herzegovina indicate that in 2021, FDI reached 578 million EUR, representing a 37.2 % increase compared to the previous year. By 2022, FDI amounted to 736.4 million EUR, marking a 27.5 % increase from the previous year and reaching the highest levels since 2007 [FIBA, 2024].

Economic growth in Bosnia and Herzegovina has followed a volatile trajectory during the post-war reconstruction period. While growth rates surged at times during the recovery, political and institutional weaknesses, alongside a lack of investment and challenges in the labor market, hindered sustainable development. The heavy blow dealt to the industrial and agricultural sectors during the war contributed to uncertainty in growth rates. Economic growth in Bosnia and

Herzegovina was relatively high between 1998 and 2007, though it was frequently obstructed by increasing institutional and political barriers [Zupcevic and Causevic, 2010: 39]. After maintaining similar growth rates in 2009 and 2010, the economy contracted by 0.7 % in 2012. Despite the Bosnian economy reaching a value of approximately 20 billion USD by 2019, growth between 2013 and 2019 remained modest, with an average annual rate of 2.8 %. In 2020, the economy contracted by 3.1 % due to the impact of the COVID-19 pandemic [DEIK, 2022]. However, the economy rebounded strongly, growing by 7.4 % in 2021 and by 4.12 % in 2022 [World Bank, 2024].

Since the early 2000s, Bosnia and Herzegovina has invested in information and communication technologies (ICT), with developments in these sectors having a positive impact on economic growth. According to reports from several institutions and organizations, the situation in Bosnia and Herzegovina in 2003 did not differ significantly from that of 2002 (Council of Ministers of Bosnia and Herzegovina, 2004: 165]. Investments in information technologies created job opportunities for the young population and accelerated the country's integration into global markets through digitalization. However, the growth of this sector remained limited, and its impact on broader economic expansion was relatively weak. The dynamics of unemployment, foreign direct investment (FDI), economic growth rates, and the development of the ICT sector in Bosnia and Herzegovina are critical in understanding the country’s transition from socialism to capitalism and the resulting economic transformation. To analyze the transformations during this period and examine the relationship between various economic indicators, one of the time series analysis methods, the ARDL (Autoregressive Distributed Lag) model, is employed, to research the impact of foreign direct investment, information and communication technology, and economic growth on unemployment in Bosnia and Herzegovina for the period 1997–2022. The study is crucial in terms of being conducted specifically in Bosnia and Herzegovina and its empirical results. The paper is organized as follows. In this paper, in the introduction part of the study, information is enlightened about the development of direct foreign investment, developments in information and technology, economic growth rates, and unemployment rates of Bosnia and Herzegovina, and then a literature review is offered in Section 2. Subsequently, Section 3 describes the data and methodology used in the study. 4 section, evaluations and recommendations are emphasized in the light of the findings.

2. LITERATURE REVIEW

2.1. Theoretical Literature Review

Unemployment has significant economic effects, particularly leading to a reduction in overall production. In the economic literature, Okun's Law emerged from a proposition put forward by Arthur Okun in 1962. Based on data from the post-World War II period in the United States (1948–1960), Okun's Law describes the inverse relationship between changes in the unemployment rate and the gap between actual and potential Gross Domestic Product (GDP). Named after the economist, this concept gained prominence through Okun's analysis of U.S. economic growth and unemployment figures. Okun observed that during years of high real growth, the unemployment rate declined, whereas, during periods of low or even negative real growth, unemployment increased. By expressing the relationship between real growth and unemployment in a formula, Okun's findings eventually referred to as “Okun's Law” [Okun, 1962: 93]. According to Okun's law, it is stated that every 1 % economic growth rate above 2.25 %, which is the average growth rate of the USA in that period, reduces the unemployment rate by 0.5 points. This law is expressed mathematically as follows:

$$\Delta u = -0{,}5(y - 2{,}25) \quad (1)$$

Where Δu denotes the change in the unemployment rate and y denotes the current period economic growth rate. In general, the relationship proposed by Okun;

$$\Delta u = \beta(y - \ y^{*}) \quad (2)$$

can be expressed as follows. In this equation, y* represents the average growth rate [Okun, 1962).

Studies in the literature examining the relationship between unemployment and economic growth: Evans [1989] in this study of the United States economy from 1950 to 1985, revealed a negative relationship between the growth of output and the rate of unemployment. Weber [1995] analyzed the relationship between cyclical unemployment rates and cyclical GDP in the U.S. economy during World War II using a dynamic model, and his results supported the Okun coefficient. Moosa [1999] sought to estimate the Okun coefficient for the United States over the period from Q1 1947 to Q2 1992 using the dynamic ARDL (Autoregressive Distributed Lag) method. These findings indicated that increased economic growth had a mitigating effect on the unemployment rate. Lee [2000] carries out an analysis covering 16 OECD countries. The results indicated that there is a cointegrating relationship between unemployment and growth variables. Silverstone and Harris [2001] analyzed the relationship between unemployment and output levels for seven OECD

member countries for the period 1978–1999 using the Asymmetric Error-Correction Model. The empirical results of the study revealed that there is no long-run relationship between unemployment and output levels of countries., Viren [2001] in this study using data from 1960 to 1997 for OECD countries, found that the curve derived from Okun's Law is non-linear. It was concluded that when the economic growth rate exceeds the long-term average growth rate, it has a negative effect on unemployment, thereby reducing it. Sogner and Stiassny [2002] in their study of 15 OECD countries, found that the response of unemployment to economic growth varies across countries. In nations with highly protected labor markets, the reaction of unemployment to growth is relatively muted, and unemployment tends to be more persistent in these countries.

The neo-liberal school, recognized as the pro-foreign investment school, disputes that foreign direct investments can have a very significant impact on the economic development of host countries. Contrary to this presentation of the pro-foreign investment school, advocates of dependency theory realize foreign direct investment as the advance guard of the new diplomacy of economic imperialism. According to them, the penetration of foreign investors into the host economy will result in 'disarticulated development' [Karimov et al., 2020: 455–456].

Economists have focused more on their effects and roles in economic theories rather than the definition of information and technology. There is an augmenting number of studies on Information and Communication Technologies in GDP and economic growth, and several articles analyzing the impact of Information and Communication Technologies investments on GDP growth [Madden and Savage, 1998; Pohjola, 2001, Jorgenson, 2001; Colecchia and Schreyer, 2001; 2002].

2.2. Literature Review of Bosnia and Herzegovina

In the literature review, studies specific to Bosnia and Herzegovina are very limited. The studies were generally conducted within the scope of Bosnia and Herzegovina, Eastern European countries, and Western Balkan countries.

Göçer and Erdal [2015] analyzed the relationship between youth unemployment and economic growth through new generation panel data analysis and cointegration tests using the Okun Law. The geographies of 18 Central and Eastern European countries were analyzed for the period 2006–2012. According to research results, it has been found that economic growth rates will diminish youth unemployment.

Kurtovic et al., [2015] examined the long-run relationship between foreign direct investment (FDI) and unemployment in the Western Balkan countries between 1998 and 2012. Panel data models, cointegration, vector error correction model

(VECM), and Granger causality test were applied in the study. According to the results of the study, it is emphasized that there is a long-term relationship between FDI and unemployment that the variables are cointegrated, and that FDI positively affects the reduction of unemployment in the Western Balkan countries.

Grahovac and Softić [2017] researched the correlation between global unemployment rates and foreign direct investment flows in the Western Balkan countries and highlighted the comparative analysis with selected countries in the period between 2000 and 2014. Only Foreign Direct Investment in Croatia has a positive effect on unemployment. In other countries, FDI inflows are insufficient to affect unemployment.

Kukaj [2018] examined the relationship between unemployment and GDP growth in 7 countries in the Western Balkans (Croatia, Bosnia, and Herzegovina, Albania, Kosovo, Serbia, Montenegro, and Macedonia,) within the period 2001–2015. According to the research findings, it is emphasized that there is a statistically important relationship between unemployment and economic growth in the Western Balkans. It has been revealed that unemployment has a negative effect on economic growth.

Mamuti and Gania [2019], in this study, the relationship between foreign direct investment and economic growth and unemployment in selected countries of the Western Balkan region (Bosnia and Herzegovina, Macedonia, Albania) was examined within the framework of the 2005–2015 periods. Multiple regression was used in the study. According to the study results, it has been demonstrated that foreign direct investment has an important effect on economic growth considering the three countries in the Western Balkans. However, the hypothesis was rejected for the country of Bosnia and Herzegovina. That is, foreign direct investment does not have an important effect on economic growth in this country. When control variables vary according to both time and cross-sectional units, it demonstrates that the effect of FDI on unemployment is not statistically significant.

Eric et al., [2020] investigated whether the Okun Law was valid for the period 2000–2019 in the economy of Bosnia and Herzegovina. Regression analysis was utilized in the study. It has been concluded that Bosnia and Herzegovina have inversely proportional trends between unemployment and GDP.

Tumanoska [2020], in this study, economic growth and youth unemployment rates for the periods 1991–2017 were examined in two ways: 7 South Eastern European countries and 14 EU countries. ARDL model and panel data analysis were utilized in the study. According to the study results, it was indicated that there was a significant relationship between economic growth and unemployment rates.

2.3. Empirical Literature Review

Table 1 demonstrates the studies in the literature in the context of unemployment and economic growth variables. The relationship between economic growth and unemployment was revealed in the study conducted for the US economy in 1962 and took its place in the literature as Okun's Law. Several studies have confirmed the validity of Okun's Law in different countries. These studies demonstrate the inverse relationship between economic growth and unemployment. The works that have proven the applicability of Okun's Law include Doğan et al. [2015], Dritsakis and Stamatio [2016], Soylu et al. [2017], Karikari-Apau, and Abeti, [2019], Khalid et al. [2021], and Amor [2023].

Table 1

The Studies in the Literature in the Context of Unemployment and Economic Growth Variables

Authors	Country	Data Period	Method	Main Results
1	2	3	4	5
Doğan et al., [2015]	Türkiye	1988–2012	Vector Autoregression Model, Johansen Cointegration Analysis, Impulse-Response Analysis	According to the research's results, it has been indicated that Okun's Law is valid between unemployment and economic growth in Turkey and the direction of the relationship changes periodically.
Dritsakis and Stamatio [2016]	Greece	1995–2015	ARDL Bound Testing and VECM Granger Causality	It has been emphasized that there is a unilateral causality relationship between unemployment and economic growth in both the short and long term and that

The Continuation of the Table 1

1	2	3	4	5
				there is a direction towards unemployment and economic growth.
Soylu et al., [2017]	Eastern European Countries	1992–2014	Panel Data Analysis	It has been shown that unemployment in Eastern European countries is positively influenced by economic growth.
Seth et al., [2018]	Nigeria	1986–2015	ARDL Bound Testing	The study's findings indicate that there is no long-term connection between the unemployment rate and economic growth in Nigeria.
Karikari-Abau and Abeti [2019]	China	1991–2018	ARDL Bound Testing	It has been emphasized that both short-term and long-term relationships exist between the unemployment rate and economic growth in the Chinese economy.
Khalid et al., [2021]	South Africa	1980–2018	VAR Analysis	The research findings indicate that there is a bidirectional causality between economic growth and unemployment in South Africa, with

The Continuation of the Table 1

1	2	3	4	5
				both influencing each other. The results of the impulse response analysis display that the response of economic growth to the unemployment rate is positively significant in the long run.
Thapa et al., [2022]	Nepal	1991–2020	The Dynamic Version Approach, Granger Causality Test	In the study, it was emphasized that Okun's law is not valid for the Nepalese economy. To the causality results, it was demonstrated that there is no causal relationship between economic growth and unemployment.
Niyangabo and Zhong [2023]	Burundi	1990–2021	ARDL Bound Testing	According to the results, it has been determined that unemployment has both short- and long-term causal effects on economic growth.
Abid et al., [2023]	Algeria	1970–2018	NARDL Model	It has been displayed that positive and negative changes in the GDP gap of the Algerian economy

The End of the Table 1

1	2	3	4	5
				have a significant negative impact on the unemployment gap in the long term.
Amor [2023]	Tunisia	1980–2020	ARDL Bound Testing	It has been shown that there is a strong cointegration between the growth rate and the unemployment rate, confirming the validity of Okun's Law.

Source: Authors' Compilation.

Table 2 displays the studies in the literature in the context of unemployment and Foreign Direct Investment (FDI) variables. Table 2 presents various studies that examine the positive and negative effects of Foreign Direct Investment (FDI) and unemployment in different countries. Some studies (Irpan et al., [2016], Alalewneh and Nessa [2020], Johnny et al., [2018], Alkopani [2020] highlight the potential of FDI to stimulate job creation, enhance productivity, and boost economic growth, ultimately reducing unemployment.

Table 2

Studies in the Literature in the Context of Unemployment and Foreign Direct Investment (FDI) Variables

Authors	Country	Data Period	Method	Main Results
1	2	3	4	5
Mucuk and Demirsel [2013]	Chile, Argentina, Colombia, Thailand, Philippines, Uruguay, Turkey,	1981–2019	Panel Data Analysis	In the 7 countries examined in the study, foreign direct investment and unemployment move along in the long term. However, while direct foreign investments increase unemployment in Türkiye

The Continuation of the Table 2

1	2	3	4	5
				and Argentina, FDI decreases it in Thailand.
Strat et al., [2015]	Latest 13 Member States of the EU	1991–2012	VAR Model, Granger Causality Test	It was determined that there was no causality relationship between the variables for six countries, but it was revealed that there was a unidirectional causal relationship in the remaining countries.
Irpan et al., [2016]	Malaysia	1980–2012	ARDL Bound Testing	It has been emphasized that FDI considerably affects the unemployment rate in Malaysia.
Garang et al., [2018]	Uganda	1993–2015	ARDL Bound Testing	The study displayed that foreign direct investment did not reduce unemployment in Uganda. It was revealed that there is no statistically important relationship in the short- and long-term dynamics of the model.
Johnny et al., [2018]	Nigeria	1980–2015	Ordinary Least Square Model (OLS)	It has been displayed that the relationship between foreign direct investment and the unemployment rate in Nigeria is negative and insignificant.
Karimov et al., [2020]	Türkiye	1980–2017	Johansen Co-Integration and Granger Causality Test	According to test result, it was revealed that there is a one-way causality from Foreign Direct Investment to unemployment. According to the Johansen Co-Integration test results, it was

The End of the Table 2

1	2	3	4	5
				determined that there was at most a cointegration between foreign direct investment and unemployment.
Alalawneh and Nessa [2020]	Egypt, Jordan, Lebanon, Morocco, Tunisia, Türkiye	1990–2018	Panel Data Analysis	By the results of the study, it has been demonstrated that foreign direct investment reduces the unemployment rate of men and women in the long run.
Alopani [2020]	Saudi Arabia	2005–2018	Ordinary Least Square Model (OLS)	It has been revealed that foreign direct investment significantly reduces the unemployment rate in Saudi Arabia country.
Ari [2021]	BRICS Countries	1992–2018	Johansen Co-Integration and Granger Causality Test	It has been indicated that there is no relationship between unemployment and foreign direct investment inflows for Brazil, China, and Russia. According to the research's results, it has been emphasized that there is a unidirectional causality relationship between unemployment and foreign direct investment inflows for India.
Warsame and Mohamed [2023]	Somalia	1991–2021	VAR model, Johansen Co-Integration, and Granger Causality Test	According to the results of the study, it is emphasized that foreign direct investments do not reduce the unemployment rate in Somalia

Source: Authors' compilation.

Table 3 indicates the studies in the literature in the context of unemployment and Information & Communication Technologies (ICT) variables. Table 3 includes findings from studies conducted in various countries, which indicate that Information and Communication Technologies (ICT) have a positive impact on reducing unemployment rates. These studies demonstrate that ICT contributes to economic growth and increases employment, thereby lowering unemployment.

Table 3

The Studies in the Literature in the Context of Unemployment and Information and Communication Technologies (ICT) Variables

Authors	Country	Data Period	Method	Main Results
1	2	3	4	5
Ebaidalla [2014]	30 Sub-Saharan African (SSA) countries	1995–2010	Dynamic Panel Data Analysis	The coefficients of Information and Communication Technology variables are negative, and it is revealed that progress in information and communication technology in Africa reduces the youth unemployment rate.
Orji et al., [2016]	Nigeria	1985–2015	Classical Linear Regression Model	Information and Communication Technology has been indicated to have a statistically important positive impact on the unemployment rate in Nigeria.
Karabulut and Shahinpour [2017]	Iran	1980–2015	ARDL	It has been determined that developments in information and communication technologies in the Iran economy have a

The Continuation of the Table 3

1	2	3	4	5
				negative effect on unemployment in both the short and long run.
Alper [2018]	23 European Union countries and Türkiye	1996–2016	FGLS Panel data analysis	Results have determined that information technology and technologies reduce unemployment both in selected European Union countries and in Turkey.
Rai and Chaturvedi [2018]	BRICS countries	1998–2016	Panel Cointegration Test, VECM, Wald Coefficient Restrictions Test	The usage of Information and Communication Technology reduced the unemployment rate in BRICS (Brazil, Russia, India, China South Africa) countries.
Karabulut et al., [2019]	A total of 42 countries, 21 developed countries, and 21 developing countries, were analyzed.	2003–2017	Panel Data Analysis	It has been indicated that expenditures on Information and Communication Technologies in developed countries do not have a significant impact on unemployment. It has been revealed that expenditures on information and communication technology have a positive impact on unemployment in developing countries.

The End of the Table 3

1	2	3	4	5
Nipo et al., [2019]	136 countries (Africa, America, Middle East, Asia, Europe)	2006–2018	Panel Data Analysis	According to results, information and communication technologies reduce the unemployment rate in all country groups except the Middle East.
Abbasabadi and Soleimani [2021]	163 countries	2016	OLS and GLS estimation methods	It has been concluded that as digital technology progresses, unemployment reaches its maximum and begins to decrease as technological development exceeds a certain value.
Postula et al., [2021]	European Union Countries	2009–2019	Panel Data Analysis	According to the results, the usage of Information and Communication Technologies had a restricted effect on unemployment in the EU.
Ogbonna et al., [2022]	41 African Countries	2003–2018	Dynamic Generalized Method of Moment (GMM)	The findings display that youth unemployment in Africa can be decreased with higher information and communication technologies deployment and usage.

Source: Authors' compilation.

There is no empirical study in the literature that examines the impact of economic growth, foreign direct investment (FDI), Information, and Communication

Technologies (ICT) on unemployment for Bosnia and Herzegovina using an Autoregressive Distributed Lag (ARDL) bounds testing approach and structural break techniques. Thus, this study aims to fill this gap in the literature, which reveals the unique value of this study**.**

3. DATA AND METHODOLOGY

The data is composed of Unemployment (% of the total labor force), Economic Growth (as a change of GDP), Foreign Direct Investment (net inflows, % of GDP), and Information and Communication Technology (Individuals Using the Internet, % Of Population) covering the period of 1998–2022. All data are obtained from the World Bank and presented in percentages due to comparability reasons. FDI is included in the model due to its significant role in economic development, particularly in developing countries like Bosnia and Herzegovina. ICT is a crucial driver of modernization and productivity improvements, making it an essential variable in the model. Economic growth is traditionally associated with job creation and reduced unemployment, as articulated by Okun's Law, which posits a negative relationship between unemployment and GDP growth. The inclusion of GDP as an independent variable is therefore crucial to capture the overall economic conditions that influence employment levels. These theoretical underpinnings justify the inclusion of FDI, ICT, and GDP in the model, aligning with the broader literature on economic growth and employment dynamics.

The logarithm of all series is taken to purify the series from small fluctuations and make them linear. Taking logarithms of the data helps to linearize relationships that may otherwise be non-linear, particularly when dealing with growth rates or multiplicative processes. This transformation not only simplifies the analysis but also reduces the impact of heteroscedasticity (i.e., non-constant variance) and small fluctuations in the data, leading to more stable and consistent results. Accordingly, LUNEMP denotes unemployment rate, LGDP denotes the economic growth rate, LICT denotes internet usage as a proxy of information and communication technology, and finally, LFDI stands for the foreign direct investment inflows.

If the variables employed in the econometric analysis are not stationary, a regression fallacy will occur, hence it is critical to check the stationarity of the data before beginning the study. Several unit root tests are performed to investigate stationarity. In the literature, the ADF [Dickey and Fuller, 1979] and PP [Phillips and Perron, 1988] tests have been extensively utilized to determine the series' stationarity status. Because of their limited size and power, both tests may be

inaccurate for small sample data sets [De Jong et al., 1992]. In this work, the NG Perron Test [2001] is used in addition to the ADF test.

We will fit the data to an Autoregressive distributed lag ARDL model [Pesaran et al., 2001]. This strategy is thought to be preferable to a comparable one in the event of a limited sample size. Because it does not impose limits on the variables of interest, the ARDL model can be used regardless of the order in which the series is integrated [Pesaran & Pesaran, 1997]. The formal ARDL model structure used in this study is as below:

$$\Delta Unemployment_t = const + \delta_{unemployment} Unemployment_{t-1} + \delta_{ICT} ICT_t + \delta_{GDP} GDP_t + \delta_{FDI} FDI_t + \sum_{i=1}^{p} \alpha_{unemployment,i} \Delta Unemployment_{t-i} + \sum_{i=1}^{p} \alpha_{ICT,i} \Delta ICT_{t-i} + \sum_{i=1}^{p} \alpha_{GDP,i} \Delta GDP_{t-i} + \sum_{i=1}^{p} \alpha_{FDI,i} \Delta FDI + \theta ECT_{t-i} + \epsilon_t, \quad (1)$$

where, $\delta_{unemployment}, \delta_{ICT}, \delta_{GDP} \delta_{FDI}$ are the long-run coefficients; $\alpha_{unemployment}$, $\alpha_{ICT}, \alpha_{GDP}$ α_{FDI} are the short-run coefficients, ECT is the error correction term, ϵ_t is the error term.

4. RESULTS AND DISCUSSION

Table 4 summarizes the first descriptive statistics of our series. It can be observed that average unemployment (LUNEMP) is 3.17 % with a standard deviation of 0.23 % and a maximum of 3.43 %. LICT, LGDP, and LFDI have a mean value of 2.84 %, 1.27 % and 1.09 % respectively.

Table 4

Descriptive Statistics

	LUNEMP	LICT	LGDP	LFDI
Mean	3.178156	2.843727	1.273533	1.093080
Median	3.278653	3.756538	1.319086	0.955511
Maximum	3.437529	4.367547	2.747271	2.459589
Minimum	2.642622	-2.302585	-0.198451	-0.223144
Std. Dev.	0.239673	1.917166	0.765400	0.577902
Skewness	-1.185904	-1.491253	-0.260810	0.407969
Kurtosis	2.996665	3.929575	2.811385	3.477711
Jarque-Bera	5.859882	10.37017	0.320483	0.931210
Probability	0.053400	0.055599	0.851938	0.627755
Sum	79.45389	71.09318	31.83832	27.32701
Sum Sq. Dev.	1.378638	88.21259	14.06010	8.015295
Observations	25	25	25	25

Source: Authors' representation.

In Table 4, the 'probability' values refer to the p-values obtained from the Jarque-Bera test, a statistical test used to determine whether the sample data has skewness and kurtosis matching a normal distribution. The Jarque-Bera test checks whether the sample data follows a normal distribution based on its skewness and kurtosis, and the null hypothesis of the test is that the data is normally distributed.

The p-value, or probability value, represents the likelihood of observing the sample data if the null hypothesis is true. A p-value greater than 0.05 suggests that there is insufficient evidence to reject the null hypothesis at the 5 % significance level, implying that the data may be normally distributed. This is why in the analysis, it was stated that the variables are normally distributed, as all p-values in Table 4 exceed 0.05.

The context of using the Jarque-Bera test in time series analysis is crucial, as normality of the residuals is often an assumption in econometric modeling, particularly in the context of Ordinary Least Squares (OLS) regression. Ensuring normality helps in validating the model's results, as it implies that the residuals are symmetrically distributed around the mean with a constant variance, which are essential assumptions for reliable statistical inference. Besides, the Kurtosis values of LUNEMP and LGDP are a little less than three. That suggests the distribution is platykurtic. The kurtosis of LICT and LFDI is more than three. That suggests the distribution is leptokurtic. In summary, all of the kurtosis values are near three, indicating that the variables are distributed normally.

Table 5

ADF Unit Root Test

Augmented Dickey-Fuller Unit Root Test			
Country	Variables	Level	1st Difference
Bosnia&Herzegovina	LUNEMP	-0.960353	-2.702495*
	LICT	-5.773700*	
	LGDP	-2.829381	-7.094590*
	LFDI	-1.113441	-5.428483*

Note: * denotes that the series becomes stationary at a 1 % level of significance.
Source: Authors' computation.

To check for the stationarity of the series, many unit root tests are used in the literature. The unit root tests in Tables 5 and 6 indicate that all series (except LICT in the ADF test) are non-stationary at level, hence the first difference [I(1)] must be taken to keep them stationary.

Table 6

NG Perron Test

Level	MZa	MZt	MSB	MPT
LUNEMP	-4.18583	-1.13246	0.27055	6.18878
LICT	0.24088	0.23686	0.98331	57.2284
LGDP	-5.61570	-1.66981	0.29735	4.37922
LFDI	-8.98404	-2.11931	0.23590	2.72753
First Difference				
LUNEMP	-9.01403	-2.10625	0.23366	2.78059
LICT	-10.1758	-2.22702	0.21885	2.51610
LGDP	-10. 1339	-2.23013	0.22007	2.49678
LFDI	-10.8853	-2.32470	0.21356	2.28221

Source: Authors' computation.

Testing for structural change is crucial in econometrics, as political, social, and economic influences can alter the connections between economic variables over time. Table 7 reveals the Bai and Perron multiple break tests. This study's testing revealed a maximum of five breaks.

Table 7

Bai-Perron break test

Sequential F-statistic determined breaks 5			
Significant F-statistic largest breaks 5			
Break test	F-statistic	Scaled F-statistic	Critical value**
1 *	130.4660	130.4660	8.58
2 *	94.98318	94.98318	7.22
3 *	69.74860	69.74860	5.96
4 *	71.50400	71.50400	4.99
5 *	67.78395	67.78395	3.91
Number of selected breaks and the years 2002, 2008, 2011, 2017, 2020			

Notes: *Significant at the 0.05 level ** Bai-Perron (Econometric Journal, 2003) critical values.

Source: Authors' representation.

The breakpoint in 2002 can be explained by the effects of the European Commission's third-party support program. Economically, this funding consisted of the improvement of the country's transport infrastructure, contribution to increased economic activity and private sector development, and improvement of the quality of university education and vocational educational training. In addition, aggressive banking reform underway since 2001 has seen some tangible improvements. Like the rest of the world, Bosnia and Herzegovina's economy was harshly affected by the global financial crisis in 2008. By 2011, the economic growth of Bosnia and Herzegovina was at the European average. Total government spending and the government's priority for health spending remained above the European average after 2008. Unemployment started rising after the onset of the crisis reaching 11.2 % in 2011 [World Bank, 2015]. Bosnia and Herzegovina officially applied to join the EU in 2016. In 2017, there were hopes of economic recovery with an increase in foreign direct investment in Bosnia and Herzegovina. However, political and legislative uncertainties led to these investments not reaching the desired level. Unemployment rates in Bosnia and Herzegovina remained high. Youth unemployment was of particular concern and was a consequence of the economic recession in the country. Despite the GDP growth of 2.7 % in 2019, Bosnia and Herzegovina experienced severe contraction in 2020 (-4.3 %), driven by reduced consumption and investment. The services sector was hit hardest by the COVID-19 pandemic, contracting by about -3.1 percentage points.

Critical values such as Akaike, Schwarz, and Hannan-Quinn are used to determine the optimal lag length. This is done by selecting the lag length with the lowest critical value. If the model experiences autocorrelation, the next lowest lag length is chosen. This process is repeated until the autocorrelation issue is resolved [Karagol et al., 2007]. In this study, the Akaike criterion suggested a lag length of 4. However, the LM test indicated the presence of autocorrelation. To address this, the appropriate lag length was adjusted to 3.

The initial method used to assess the long-term relationships between the series is the cointegration Bounds test [Pesaran, Shin, & Smith, 2001]. The F-statistic indicates whether long-term correlations exist between the series. Once cointegration is confirmed, the ARDL model can analyze both long- and short-term relationships. The results of the bounds test are shown in Table 8.

Table 9 demonstrates the long-term coefficients obtained using the estimated results of the ARDL (1, 3, 2, 3) model. The results illustrate that the GDP coefficient

(LGDP) has a negative and significant influence on unemployment at the 1% level of significance. The coefficient of foreign direct investment (LFDI) depicts a positive and significant relationship with unemployment at 1 percent. Lastly, the coefficient of information and communication technology (LICT) shows a negative and insignificant relationship with unemployment in the long run.

Table 8

Bounds Test Results

Statistics	**Critical Values****		
	Lower Bound I(0)	**Upper Bound I (1)**	**Conclusion**
F-Statistics			
3.886955	2.676	3.586	Cointegration

Note: ** at 10 % significance.

The coefficient of the lagged error correction term (ECT) is found to be negative and statistically significant. The coefficient of the ECT indicates that the error correction model of the model is working and the model is significant and shows how much of the imbalance in the short run will be corrected in the long run. Specifically, approximately 31 percent of the deviation from the equilibrium is adjusted each period, meaning that the model gradually returns to its long-run relationship after short-term shocks. It indicates that the speed of adjustment is low.

Table 9

ARDL (1,3,2,3) Model Results

Long-Run Coefficients				
1	**2**	**3**	**4**	**5**
Variables	Coefficient	Standard Dev.	t-Statistics	Prob.
LICT	-0.095800	0.085879	-1.115527	0.2793
LGDP	-0.703436*	0.180036	-3.907201	0.0010
LFDI	0.448380*	0.154654	2.899243	0.0096
Short-Run Coefficients				
LUNEMP(-1)	-0.310302**	0.132948	-2.334010	0.0445
LICT	0.084145	0.052525	1.602011	0.1332
LICT(-1)	0.129709**	0.043345	2.992469	0.0104
LICT(-2)	0.096274***	0.053278	1.807021	0.0939
LGDP	-0.047584	0.029827	-1.595347	0.1346
LGDP(-1)	0.094943**	0.042300	2.244488	0.0428

The End of the Table 9

1	2	3	4	5
LFDI	-0.06177	0.026644	-0.231824	0.8203
LFDI(-1)	-0.149579*	0.034765	-4.302601	0.0009
LFDI(-2)	-0.094667**	0.034819	-2.718811	0.0176
ECT(-1)	-0.310302	0.058566	-5.298344	0.0001
	Number of Obs.	R-Squared	Adjusted R-Squared	Log Likelihood
	25	0.729829	0.563571	37.99342

Source: Authors' Computation.

Note: *, **, *** 1 percent, 5 percent, and 10 percent denote significance at one percent, five percent, and ten percent levels.

The results of the diagnostic tests provide strong evidence that the model's estimation is accurate. To check for autocorrelation in the residuals, a Breusch-Godfrey serial correlation LM test was conducted. Since the p-value is greater than 1 %, we cannot reject the null hypothesis of no autocorrelation, meaning our model does not exhibit autocorrelation. The Breusch-Pagan-Godfrey test was applied to assess heteroskedasticity, and the model was found to be free from it. The Jarque-Bera test was used to examine the normality of the residuals, with normality tested at the 1 % and 5 % significance levels. Additionally, the Ramsey RESET test for model misspecification confirmed that the model is correctly specified. All test results are summarized in Table 10.

Table 10

Diagnostic Test Results

Diagnostic Test Techniques	Statistics	Probabilities
Serial Correlation (LM Test)	7.323151	0.0257
Heteroskedasticity (Bresuch-Pagan-Godfrey Test)	11.38639	0.4961
Normality Test (Jarque Bera)	0.081955	0.959851
Ramsey Reset Test	0.368215	0.5608

Source: Authors' Representation.

In addition, the results of CUSUM and CUSUM 2 test statistics are shown in Figure 1 and Figure 2, respectively. The results show that these test statistics are within

the 5 % critical thresholds and therefore the long-run parameters are stable. This allows for a policy that is more robust implications for the Bosnian economy in the long run.

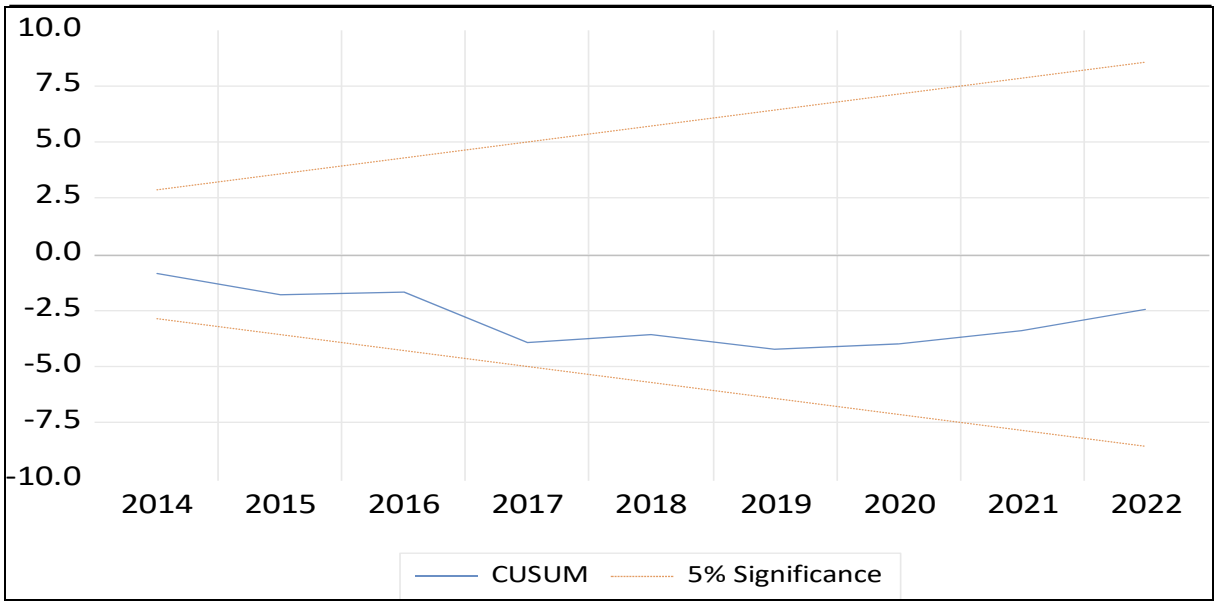

Figure 1. CUSUM Test Results

Source: Author's Computation.

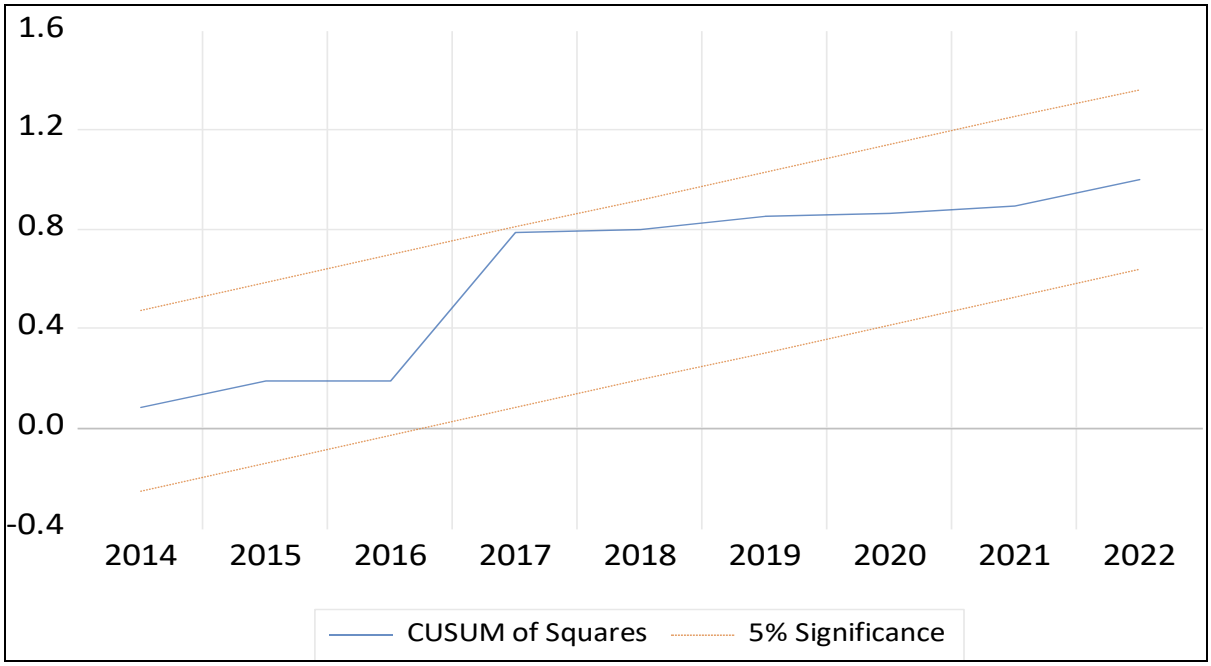

Figure 2. CUSUM of squares test results

Source: Author's Computation.

5. CONCLUSION AND POLICY RECOMMENDATIONS

Economic growth, FDI, and ICT are significant factors that often have the potential to create employment. Especially in developing countries, investments in these areas play a critical role in stimulating the labor market and reducing unemployment rates. In this context, this study empirically investigates the effects of economic growth, FDI, and ICT on unemployment in Bosnia and Herzegovina. The findings provide insights into how these factors influence the labor market. While the results can inform the development of effective strategies to combat unemployment, the primary aim of this paper is to contribute to the existing literature by providing empirical evidence specific to Bosnia and Herzegovina. These strategies are aimed to contribute to the sustainable development of Bosnia and Herzegovina.

In the econometric section of the study, the relevant variables were investigated using the ARDL Bound Test and the structural break technique, using data spanning 1997–2022. The results indicate that GDP negatively influences the unemployment rate in the long run in Bosnia and Herzegovina. A one-point increase in GDP leads to a 0.70 percent point decrease in unemployment rate. This means that *Okun's law* is valid for Bosnia and Herzegovina. Furthermore, the attained Okun coefficient is more than that of the actual Okun coefficient, which was documented by Arthur Okun [Okun, 1962]. This result is in line with the findings from Erić et al [2020].

Although the results indicate a negative relationship between ICT and unemployment in Bosnia and Herzegovina, this effect is statistically insignificant. Therefore, while there is a suggestion that technological innovations could potentially reduce unemployment by fueling economic growth; the evidence from this study is not strong enough to confirm this relationship. Further research with more robust data and methods would be needed to draw definitive conclusions.

There is also a positive and significant connection between FDI and unemployment. A one percent increase in the amount of FDI inflow to Bosnia and Herzegovina leads to a 0.44 increase in unemployment. This result confirms the *dependency theory*, which advocates the influx of foreign investors into the host country may damage the economic structure and increase unemployment. FDI may increase unemployment for several reasons:

- Technological Progress and Automation: Foreign investments often bring technology and increase the productivity of enterprises. This may reduce the need for some labor and increase unemployment. In particular, automation and robots may replace routine and low-skill jobs [Karimov et al. 2020].

- Competition and Business Closures: As foreign investments compete with local businesses, some local businesses may not survive this competition and may close down. This may increase unemployment rates [Grahovac and Softić, 2017].
- Utilisation of Local Resources: Foreign investors usually bring their resources and prefer their suppliers. This may reduce the access of local enterprises to resources and thus increase the risk of unemployment [Johnny et al., 2018].
- Labour Conditions and Trade Union Rights: In some cases, labor conditions and trade union rights in countries where foreign investments come from may be lower than local standards. This may increase the unemployment risk of the local labor force [Brookings Institution, 2020].
- Type of FDI: The type of investment can affect employment. Greenfield and brownfield investments can each have different impacts on the labor force. Greenfield investments usually refer to the creation of completely new businesses, such as the construction of new factories or plants. This type of investment usually has the potential to create more jobs because new job positions are created for the establishment of new businesses. In addition, there is often a need for advanced skills such as technology and management skills, which can create opportunities for training and development of the local labor force. [EBRD, 2021]

In light of these reasons, structural problems in Bosnia and Herzegovina's economy, such as the fact that a large portion of FDI inflows are reinvested earnings, foreign greenfield investments remain intact, the informal economy is large, political uncertainty, skills shortages in the labor market, brain drain, and business disincentives [EC, 2023] all contribute to FDI's negative impact on unemployment. Furthermore, Bosnia and Herzegovina is still in the early stages of planning for digital transformation and media. Bosnia and Herzegovina has yet to adopt legislation relating to electronic communications and electronic media in accordance with the 2018 EU regulatory framework 98, nor has it made any progress in aligning with the EU Broadband Cost Reduction Directive.

In conclusion, our study reveals the complex interactions between economic growth, FDI, and ICT in influencing unemployment in Bosnia and Herzegovina. While FDI and ICT have varying impacts on unemployment, the evidence suggests that economic growth plays a critical role in reducing unemployment, consistent with Okun’s Law. The findings underscore the need for targeted economic policies that enhance the benefits of FDI and ICT while mitigating potential adverse effects on the labor market.

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