UNEMPLOYMENT IN THE COUNTRIES OF CENTRAL AND EASTERN EUROPE - STAGNANT OR DYNAMIC?

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Abstract

The subject of the analysis is the phenomenon of unemployment in the countries of Central and Eastern Europe of the European Union in 2011-2022, considered both from the stock and flow perspective. The flow approach allows to assess whether unemployment is stagnant or dynamic. The article shows the differences between the studied countries in terms of unemployment rates, indicators of people's flows between employment and unemployment, and the determinants influencing both variables.

The analyses show that the lowest unemployment rates occurred in the Czech Republic, Slovenia, and Poland, and the highest were in Slovakia, Latvia, and Lithuania. In contrast, the highest dynamics of flows of people on the labour market occurred in Estonia and the lowest in Bulgaria and Romania. This indicates a stagnant nature of unemployment in the latter two countries. The econometric analyses show that the factors significantly influencing the increase in the dynamics of the flow of people in the labour market were the increase in the share of temporary employment, the increase in the share of part-time jobs and the increase in investments in the economy.

Keywords: *labour market, unemployment rate, flows of people in the labour market, stagnant and dynamic unemployment, Central and Eastern European countries*

1. INTRODUCTION

Several fundamental changes have occurred in the labour markets of the European Union's Central and Eastern European countries over the last three decades. These changes resulted from several significant external shocks that occurred during this period. Firstly, at the turn of the 1980s and 1990s, the transformation of the economic system towards a market economy began, which had a significant impact on labour markets, leading to the emergence of open unemployment. Secondly, the first decade of the 21st century meant that some countries in Central and Eastern Europe, including Bulgaria, could obtain membership in the European Union, which involved introducing various institutional adjustments, including labour market institutions. Third, the region experienced two adverse economic shocks related to the Russian crisis at the turn of the century and the global financial crisis in 2008 and 2009. Fourth, in 2020, the COVID-19 pandemic began, significantly affecting the economy and the labour market. These shocks had a significant impact on unemployment in the region.

Two approaches are used in the analysis of unemployment undertaken in the economic literature: stock-based and flow-based. In the initial period of the economic system transformation in the countries of Central and Eastern Europe, including Bulgaria, unemployment research was developed primarily using a stock-based approach. It was justified because it allowed recognising trends in the unemployment pool and unemployment rates and changes in unemployment structures according to various division criteria. However, it quickly turned out that the stock-based approach had its limitations, as it did not allow recognising several essential features of unemployment, mainly related to the level of turnover of people in the unemployment pool, the flow of people between labour market states and the duration of unemployment, which determine the stagnant or dynamic nature of unemployment. Recognising these features requires a flow approach to analysis.

The subject of the analysis in this article is the phenomenon of unemployment in the countries of Central and Eastern Europe of the European Union, considered both from the stock and flow perspective. The analyses cover the period 2011-2022. The studied countries include Bulgaria, Croatia, the Czech Republic, Estonia, Lithuania, Latvia, Poland, Romania, Slovakia, Slovenia, and Hungary. The focus is on unemployment rate indicators based on the stock-based approach and indicators of people's flows

between the unemployed and employed based on the flow approach. Flow indicators are essential in assessing unemployment's stagnant or dynamic nature.

The article's analyses aim to show the differences between the studied countries in terms of unemployment rates and people flow rates and to indicate the factors influencing these variables. The analyses aim to show which countries had the lowest and highest unemployment rates and where the flow rates of people were the lowest, indicating the stagnant nature of unemployment and where the flows were the highest, suggesting dynamic unemployment. Special attention will be devoted to Bulgaria to illustrate its results compared to other analysed countries. The analyses also aim to indicate what role such variables as GDP dynamics, investment rates, and types of employment contracts play in shaping unemployment rates and flow indicators.

The order of further considerations in the article is as follows. Part 2 reviews unemployment research in Central and Eastern European countries, with particular emphasis on Bulgaria and the application of the flow approach. Part 3 is devoted to the presentation of data and the research methods used. Part 4 presents the groupings and rankings of the studied countries according to unemployment rates and indicators of flows between unemployment and employment. Econometric panel models, indicating the role of several factors determining unemployment rates and flow rates in the studied countries, are discussed in Part 5. Part 6 contains more critical conclusions from the analyses that were conducted, particularly emphasising the results for Bulgaria.

2. REVIEW OF RESEARCH IN ECONOMIC LITERATURE

Analyses of labour markets in Central and Eastern European countries are carried out from both the resource and flow perspectives. This allows for a better understanding of various aspects of unemployment in this region.

T. Boeri (1999) considered the problem of the optimal pace of economic reforms in transformation countries, using data on the flows of people between the resources of the employed, the unemployed and the economically inactive from the 1990s. In Poland, the outflows of people from employment to professional inactivity were more significant than those from employment to unemployment, which inhibited the increase in unemployment. According to Boeri, implementing economic reforms cannot be too fast because it may cause high unemployment and social unrest. However, it cannot be too slow because the resources necessary for developing the private sector must be released.

A. Nesporova and S. Cazes (Nesporova, 2002; Cazes, Nesporova, 2004) examined persistently high unemployment in transformation countries, pointing to greater flexibility of labour markets and growing rates of temporary employment and flows of people in the labour market. The authors concluded that the responsibility for supporting people dismissed from work had been transferred from enterprises to public institutions, increasing labour market flexibility. Still, the effectiveness of financial assistance to the unemployed depends on the quality of operation of these institutions. They also emphasised the need to improve education and training systems to better adapt employees' skills to the needs of the labour market.

G. Gozgor (2013) examined the causes of high unemployment, analysing the NAIRU theory and unemployment hysteresis hypothesis. The data analysis from 1998-2012 showed that the persistence of unemployment rates in Central and Eastern European countries is consistent with the hysteresis hypothesis, suggesting that adverse shocks have a lasting impact on unemployment levels. Gozgor emphasized that periods of recession can have long-lasting effects on the labour market, increasing the difficulty of returning to low unemployment rates even after the economic situation improves. Bulgaria, as one of Central and Eastern European countries, is also an essential area for analysis. In the context of economic reforms, Bulgaria faced challenges related to transforming the economy from a centrally planned to a market-based economy. This process was associated with high levels of unemployment, especially in the 1990s, when many state-owned enterprises went bankrupt and new jobs in the private sector needed to be created more quickly. In recent years, Bulgaria has experienced some successes in reducing unemployment, but structural problems remain. The increase in employment in sectors such

as IT and service outsourcing indicates the possibility of dynamic development. However, at the same time, a large part of the population in rural regions still struggles with high unemployment and limited access to new jobs. Data from 2004-2013 show that in the good economic years (2004-2008), Bulgaria, like other countries in the region, recorded a decline in unemployment thanks to increased employment. However, the global financial crisis of 2008-2010 saw unemployment rates increase, significantly affecting the country's economy. This crisis's social and economic consequences were evident in industrial and agricultural areas, where unemployment rose to alarming levels. As in other countries in the region, the flexibility of the labour market in Bulgaria has become a critical factor in adapting to changing economic conditions. Reforms aimed at liberalising employment and dismissal regulations helped companies adapt to new realities but also contributed to increased employment instability and precarization of work.

To sum up, foreign research shows the complexity of the unemployment issue in the Central and Eastern European region, emphasising the impact of economic reforms, the flexibility of labour markets, and the lasting effects of adverse economic shocks. Bulgaria, an example of a country undergoing complex transformation processes, illustrates the challenges of simultaneous employment growth in some sectors and persistent structural problems that require comprehensive and coordinated labour market policy action.

3. DATA AND METHODOLOGY

This article analyses annual data on labour markets in Central and Eastern European countries belonging to the European Union in 2011-2022. These data from the Eurostat database include information on unemployment rates and the flow of people between employment and unemployment. The article uses two leading indicators to assess labour markets: the unemployment rate and the flow rate of people between unemployment and employment. The choice of these indicators results from their information value. The unemployment rate allows you to assess the degree of utilisation of labour resources, which is crucial for analysing the situation in the labour market. However, the unemployment rate does not reflect the dynamics of the turnover of unemployed people or the period for which they remain jobless. The adverse effects of unemployment depend not only on its level but also on how widely the phenomenon affects the population and how long unemployment lasts. To capture these aspects, it is necessary to look at the flows of people between unemployment and employment. Therefore, the article also adopted an indicator of the intensity of people's flows between unemployment and employment, calculated according to the following formula:

$$if_{it}=\frac{EU_{it}+UE_{it}}{U_{it}} \quad (1)$$

where the following designations were adopted:

if_{it}– indicator of the intensity of flows of people between the unemployment pool and the employment pool in country i in year t,

EU_{it}– inflow of people into the unemployment pool from the employment pool in country i during year t,

UE_{it}– the outflow of people from the unemployment pool to the employment pool in country i during year t,

U_{it} – number of unemployed people in the country and at the end of the year t.

The intensity of people flows influences the duration of unemployment. Higher values of this indicator, meaning a higher turnover of people in the unemployment pool, are associated with shorter periods of unemployment and a more dynamic nature of this resource. However, lower values of the indicator

suggest more extended periods of unemployment and more significant stagnation of the unemployed population. Both indicators form the basis for grouping countries.

The grouping method is based on the arithmetic means of unemployment rates and flow indicators ($\overline{ur}, \overline{if}$)and standard deviations of both indicators (s_{ur}, s_{if}), by the principles presented in Table 1. As a result of this grouping, countries were divided into nine groups marked with the letters A to I. The most favourable market situation is represented by countries from group A, where high flow rates accompany low unemployment rates. In turn, the most challenging problem is in the countries of group I, where there are high unemployment rates and low rates of people flows.

	Unemployment rate (sb)		
Flow intensity indicator on the labour market (if)	group A $ur_i < \overline{ur} - s_{ur}$ $if_i > \overline{if} + s_{if}$	group B $\overline{ur} - s_{ur} < ur_i < \overline{ur} + s_{ur}$ $if_i > \overline{if} + s_{if}$	group C $ur_i > \overline{ur} + s_{ur}$ $if_i > \overline{if} + s_{if}$
	group D $ur_i < \overline{ur} - s_{ur}$ $\overline{if} - s_{if} < if_i < \overline{if} + s_{if}$	group E $\overline{ur} - s_{ur} < ur_i < \overline{ur} + s_{ur}$ $\overline{if} - s_{if} < if_i < \overline{if} + s_{if}$	group F $ur_i > \overline{ur} + s_{ur}$ $\overline{if} - s_{if} < if_i < \overline{if} + s_{if}$
	group G $ur_i < \overline{ur} - s_{ur}$ $if_i < \overline{if} - s_{if}$	Group H $\overline{ur} - s_{ur} < ur_i < \overline{ur} + s_{ur}$ $if_i < \overline{if} - s_{if}$	group I $ur_i > \overline{ur} + s_{ur}$ $if_i < \overline{if} - s_{if}$

Table 1. Grouping method based on the standard deviation from the arithmetic mean of indicators

Source: own study.

To present a complete picture of the situation in the labour markets in Central and Eastern European countries, rankings were prepared, considering both unemployment and flow rates. Hellwig's (1968) linear ordering method was used to build the rankings. Variables of the unemployment rate and flow rate are standardised. In this analysis, the unemployment rate was treated as a destimulant, and the flow rate was treated as a stimulant. The standardised unemployment rate variable was then transformed into a stimulus measure. The arithmetic mean was calculated assuming equal weights for both variables. The rankings were prepared in descending order, i.e. ordering countries from those with the best situation (low unemployment rates and high flow rates) to those with the most challenging situation (high unemployment rates and low flow rates).

Estimates of the average duration of unemployment for steady-state conditions were also made by calculating the relationship between the unemployment pool and the amount of outflows of people from the unemployment pool.

In the second stage of the research conducted in this article, econometric models were constructed to verify the significance of the impact of factors determining unemployment rates and people flow rates in the analysed countries. The selection of explanatory variables for the models was based on the theoretical achievements of economics and the availability of statistical data. The primary determinants influencing unemployment rates and the flow of people between unemployment and employment in the EU countries from Central and Eastern Europe include:

– change in GDP year/year in %,
– ratio of temporary employment to total employment in %,
– ratio of part-time jobs to total employment in %,

- share of investment in GDP in %,
- share of people with higher education in the number of professionally active people in %,
- share of employment in knowledge-intensive fields in total jobs in %,
- a dummy variable taking the value of 1 in 2020 and zero in other years to capture the impact of the COVID-19 pandemic on labour markets in the analysed countries.

The mentioned variables are included in relative formulas, allowing for comparisons between countries.

The econometric analysis was carried out based on cross-sectional data (annual data from 2011-2022 in 11 EU countries from Central and Eastern Europe), using power functions whose general form after logarithm is as follows:

$$ln\_ur_{it} = \alpha_0 + \alpha_1 ln\_X_{1,it} + \ldots + \alpha_n ln\_X_{n,it} + \varepsilon_{it} \quad (2)$$

$$ln\_if_{it} = \alpha_0 + \alpha_1 ln\_X_{1,it} + \ldots + \alpha_n ln\_X_{n,it} + \varepsilon_{it} \quad (3)$$

Where:

ur_{it} – unemployment rate in country i in year t,

if_{it} – indicator of the intensity of flows of people between unemployment and employment in country i in year t,

$X_{1it} - X_{nit}$ explanatory variables in country i in year t,

ε_{it} – random component,

α_0 – intercept,

$\alpha_1 - \alpha_n$ – parameters with explanatory variables.

The subject of estimation in the models are the parameters $\alpha_0, \alpha_1, \ldots .. \alpha_n$. An elastic approach is used to interpret the estimation results, which means that the estimated values of the α indicate a percentage increase or decrease in the values of the explained variables resulting from an increase in the value of the explanatory variable by 1%, assuming *ceteris paribus*.

4. GROUPINGS AND RANKINGS OF COUNTRIES ACCORDING TO THE LEVEL AND NATURE OF UNEMPLOYMENT

Chart 1 illustrates the development of unemployment rates and indicators of people's flows between unemployment and employment in the eleven analysed countries in 2011-2022.

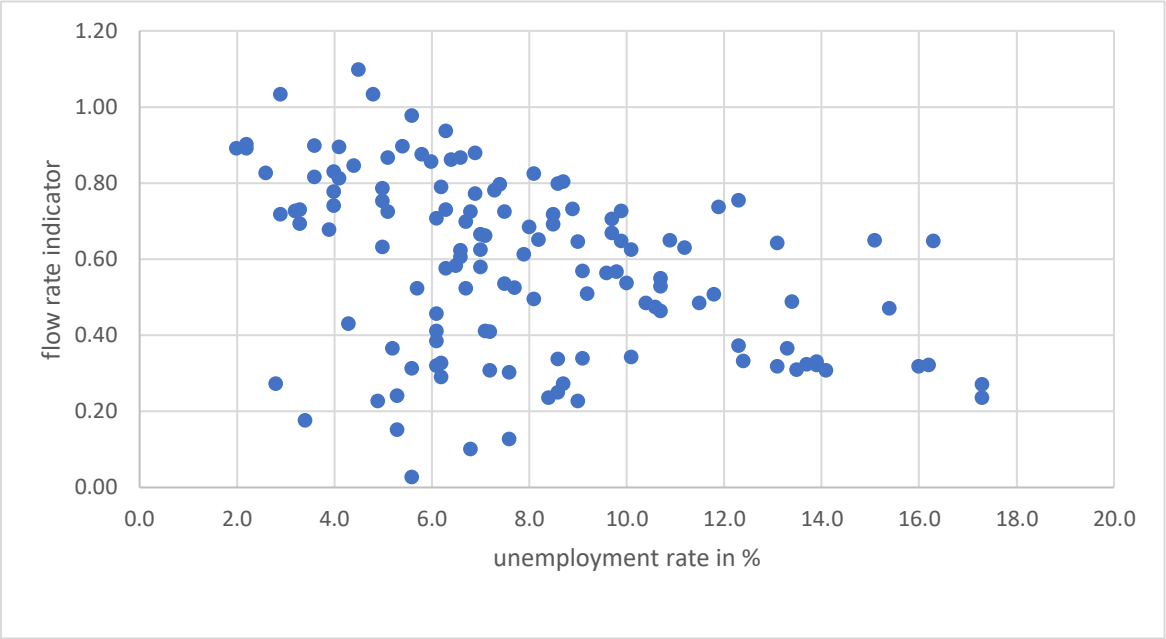

Chart 1. Indexes of intensity of flows and unemployment rates in Central and Eastern European countries in 2011-2022, N=132

Source: own study based on Eurostat data

Based on the data presented in Chart 1, a clear relationship between both indicators can be seen. In most cases, higher unemployment rates were accompanied by lower flow rates. This means that the better situation in labour markets, reflected in relatively low unemployment rates, was related to the more dynamic nature of this unemployment. In other words, lower unemployment rates indicated a higher turnover of people in the unemployment pool, which suggested shorter periods of unemployment. This state of affairs allows us to conclude that a more dynamic labour market is characterised not only by a lower level of unemployment but also by greater mobility of people who quickly find new employment.

These results are essential for employment policy because they emphasize the importance of creating conditions conducive to maintaining a low level of unemployment but also to its dynamic structure of flows.

Table 2 shows the grouping of the analysed countries based on indicators averaged over the entire period of 2011-2022. As Table 2 shows, during the whole period under study, the lowest unemployment rate was recorded in the Czech Republic, while the highest was in Croatia. In turn, the most dynamic nature of the unemployment rate occurred in Slovenia and Estonia and the most stagnant in Bulgaria and Romania.

	unemployment rate (ur)		
labor market flow index (if)	**group A** -	**group B** Slovenia Estonia	**group C** -
	group D Czechia	**group E** Slovakia Poland Hungary Lithuania Latvia	**group F** Croatia
	group G -	**H group** Bulgaria Romania	**group I** -

Table 2. Grouping in EU countries from Central and Eastern Europe based on average values for 2011-2022

Source: own study based on Eurostat data

This grouping of countries allowed for a better understanding of the differences in the structure of labour markets in individual countries and the identification of specific challenges in the field of employment policy. Countries with dynamic labour markets can serve as examples for those struggling with higher and more stagnant unemployment, pointing to possible directions for reforms and corrective actions.

Table 3 presents the ranking of Central and Eastern European countries based on unemployment rates and flow intensity indicators for 2011-2022. The table uses a linear ordering index, which allows countries to be ranked from best to worst in the labour market.

Country	**Linear ordering indicator**
Czechia	2,192
Hungary	1,705
Estonia	1,642
Slovenia	1,633
Poland	1,216
Latvia	0.808
Lithuania	0.682
Romania	0.250
Bulgaria	0.075
Slovakia	0.056
Croatia	-0.360

Table 3. Ranking of countries based on average unemployment rates and flow intensity indicators for 2011-2022

Source: own study based on Eurostat data

As shown in Table 3, the Czech Republic ranks first with an index of 2.192, which means it has the most favourable situation in the labour market among the analysed countries. The following places are taken by Hungary (1,705), Estonia (1,642) and Slovenia (1,633). These are countries characterised by relatively low unemployment rates and dynamic rates of movement of people between unemployment and employment. Poland ranks fifth with an index of 1,216, proving a relatively good situation in the labour market. Lithuania (0.682) and Latvia (0.808) are in the middle of the pack, which suggests a moderate problem in their labour markets.

Romania, with an index of 0.250, and Bulgaria, with an index of 0.075, are in the lower part of the ranking, which indicates a more significant stagnation of unemployment and a less dynamic labour market.

Bulgaria, in penultimate place with an index of 0.075, is characterised by one of the most challenging labour market situations among the analysed countries. This means that in Bulgaria, the average unemployment rate was higher, and the rates of movement of people between unemployment and employment were lower compared to most other countries in the ranking. Croatia is in last place with an index of -0.360, which indicates the highest average unemployment rates and the lowest flow intensity indicators in the analysed period.

Table 3 offers detailed insight into the differences in labour market situations across countries, allowing for a better understanding of their specific challenges. The conclusions from the analysis may constitute the basis for further research and the formulation of employment policies aimed at reducing unemployment and increasing professional mobility.

Chart 2 shows the relationship between the unemployment rate (X-axis) and the indicator of the intensity of people's flows between the unemployment pool and employment (Y-axis) for the years 2011 and 2022.

These data illustrate critical changes in the labour market during the analysed years. Based on the chart, a meaningful relationship can be noticed: the lower the unemployment rate, the higher the flow rate. This means that when unemployment is low, more people quickly move from unemployment to employment, indicating a more dynamic labour market.

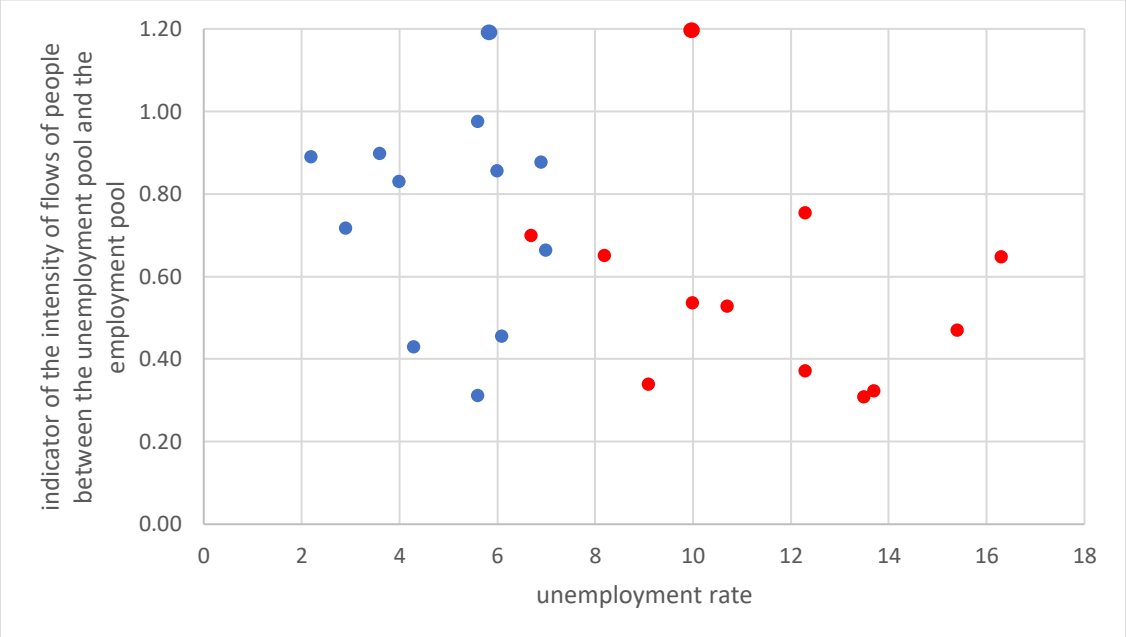

Chart 2. Unemployment rate and the intensity of people flows in EU countries from Central and Eastern Europe in 2011 and 2022

Source: own study based on Eurostat data

In 2011, unemployment rates were higher, and flow rates were lower. This was when labour markets in many countries struggled with higher unemployment levels and lower mobility of job seekers. This was related to the consequences of the global financial crisis. However, in 2022, the situation has improved. Unemployment rates were significantly lower than in 2011, and at the same time, flow rates were higher.

This situation suggests that labour markets have become more dynamic, which means that the unemployed have found employment faster. The employment policies implemented in the analysed period may have improved the labour market situation, leading to lower unemployment rates and higher occupational mobility.

The graph clearly shows an inverse relationship between the unemployment rate and the flow intensity index. The improvement in these indicators in 2022 compared to 2011 is testimony to the positive changes in labour markets, which have brought lower unemployment rates and more dynamic flows of people between unemployment and employment.

2011			
unemployment rate (ur)			
labor market flow indicator (if)	**group A** Czechia	**group B** **Estonia**	**group C** -
	group D Slovenia	**group E** Poland Bulgaria **Hungary**	**group F** Lithuania **Latvia**
	group G -	**H group** Slovakia Croatia Romania	**group I** -
2022			
unemployment rate (ur)			
labor market flow indicator (if)	**group A** -	**group B** **Estonia**	**group C** -
	group D Czechia Poland	**group E** Lithuania **Hungary** Slovenia	**group F** Croatia **Latvia**
	group G -	**H group** Bulgaria Romania Slovakia	**group I** -

Table 4. Grouping of countries according to unemployment rates and people flow intensity indicators in 2011 and 2022. Countries that were in the same group in both years are in bold.

Source: own study based on BDL data of the Central Statistical Office and reports of district labour offices

In 2011 - 2022, the labour market in Central and Eastern European countries underwent significant changes, which can be observed based on the indicators of the flow of people between the unemployment pool and employment and unemployment rates. In 2011, countries such as Estonia, Poland and the Czech Republic had a favourable labour market situation characterised by low unemployment rates and high employment flows. At the same time, Lithuania, Latvia and Bulgaria had a more complex situation in the labour market, with higher unemployment and lower employment dynamics. In 2022, there have been changes among these groups. Estonia, Poland, and the Czech Republic maintained their position in the group of countries with stable and favourable conditions in the labour market. In contrast, Lithuania, Latvia and Bulgaria have moved towards more favourable conditions, improving their labour market indicators thanks to reduced unemployment rates and increased employment flows. Lithuania and Slovenia have distinguished themselves by significantly improving their situation.

In summary, despite some progress, countries such as Romania, Bulgaria and Slovakia still need to overcome challenges characterised by high unemployment rates and low labour flows. This highlights the need for further action and reforms to better adapt to changing economic conditions.

No.	**Year 2011**	**No.**	**Year 2022**
1	Czechia	*1*	Czechia
2	Slovenia	*2*	Hungary
3	Estonia	*3*	Poland
4	Poland	*4*	Slovenia
5	Hungary	*5*	Estonia
6	Romania	*6*	Lithuania
7	Latvia	*7*	Latvia
8	Bulgaria	*8*	Bulgaria
9	Lithuania	*9*	Croatia
10	Slovakia	*10*	Slovakia
11	Croatia	*11*	Romania

Table 5. Rankings (descending order) of countries according to the total intensity of people flows and unemployment rate in 2011 and 2022

Source: own study based on Eurostat data

Several significant changes in the ranking can be noticed in these two periods. The Czech Republic retained first place in 2011 and 2022, which suggests a stable situation regarding the intensity of people flows and the unemployment rate. Hungary has moved significantly from 5th place in 2011 to 2nd place in 2022. This may indicate an improvement in the economic situation and lower unemployment. Poland also improved its position, moving from 4th place in 2011 to 3rd place in 2022. Romania recorded the most significant deterioration, falling from 6th place in 2011 to the last, 11th place in 2022.

These conclusions are confirmed by the data in Table 6, which presents the ratios between the unemployment stock and outflows from unemployment. This ratio is the basis for estimates of the average duration of unemployment for steady-state conditions, i.e. a situation where the total outflows of people from unemployment were equal to the inflows of people into unemployment. These indicators are essential for assessing unemployment's degree of stagnation/dynamic nature.

Country	U/((EU)+(UI)) - in years	
	2011 - 2016	2017- 2022
Bulgaria	2.82	2.58
Czechia	1.66	1.29
Estonia	1.41	1.40
Croatia	4.77	1.44
Latvia	1.48	1.50
Lithuania	2.15	2.04
Hungary	1.86	1.49
Poland	2.11	1.33
Romania	2.89	2.59
Slovenia	1.80	1.34
Slovakia	3.34	2.42

Table 6. Estimates of the average duration of unemployment for steady-state conditions (in years)

Source: own study in STATISTICA

These estimates were calculated based on the ratio of the unemployment stock in a given period to the outflow of people from unemployment. Calculations were carried out for 2011-2016 and 2017-2022. The relations between the unemployment stock and unemployment outflows provide some indication of the nature of unemployment, the lower the value of the indicator, the better the situation in the labour market and the more dynamic the nature of the unemployment pool. The data in Table 6 confirm that in the studied group of countries in 2017-2022, the best situation in the labour market was in the Czech Republic, Slovenia and Poland. The highest values of the indicator and, therefore, the least favourable nature of unemployment occurred in Slovakia and Bulgaria, suggesting a stagnant unemployment rate.

5. DETERMINANTS OF THE LEVEL AND NATURE OF UNEMPLOYMENT - MODEL ANALYSIS

In the model analysis, the parameters of two regression functions were estimated, which take the following form:

$$ln\_ur_{it} = \alpha_0 + \alpha_1 ln\_GDP_{it} + \alpha_2 ln\_TE_{it} + \alpha_3 ln\_PTE_{it} + \alpha_4 ln\_INV_{it} + \alpha_5 ln\_HE_{it} + \alpha_6 ln\_KIE_{it} + \alpha_7 ln\_\text{PAND\_01}_{it} + \varepsilon_{it} \quad (4)$$

and

$$ln\_if_{it} = \alpha_0 + \alpha_1 ln\_GDP_{it} + \alpha_2 ln\_TE_{it} + \alpha_3 ln\_PTE_{it} + \alpha_4 ln\_INV_{it} + \alpha_5 ln\_HE_{it} + \alpha_6 ln\_KIE_{it} + \alpha_7 ln\_\text{PAND\_01}_{it} + \varepsilon_{it} \quad (5)$$

Where the following designations were adopted:

ur_{it} – unemployment rate registered in country i at the end of year t,

if_{it} – indicator of the intensity of flows of people between unemployment and employment in country i in year t,

GDPit – year-on-year change in GDP in % in country i in year t,

TEit – share of temporary employment in total employment in % in country i in year t,

PTEit – share of part-time employment in total employment in % in country i in year t,

INVit – share of investment in GDP in % in country i in year t,

HEit – share of people with higher education in the number of professionally active people in % in country i in year t,

KIEit – share of employment in knowledge-intensive fields in total employment in % in country i in year t,

PAND – a dummy variable taking the value 1 in 2020 and zero in other years in country i in year t,

ε_{it} – pure random error.

The same set of explanatory variables was used for both regressions. All variables, except dummy variables, were logarithmised. The correlation matrix for the variables and selected descriptive statistics are presented in Tables 8 and 9 in the Appendix, respectively.

The estimates of the regression parameters are presented in Table 7. Statistically significant estimates at the 0.05 significance level are those parameters for which the absolute values of the student's t-statistic are more critical than 2.3 and the p-value < 0.05. When analysing the estimation results of the unemployment rate and the flow model, it should be emphasised that the estimates of not all parameters were statistically significant. The following variables are statistically significant for the unemployment rate model at the 0.05 significance level: PTE, INV, HE, and PAND.

The following variables for the flow model are statistically significant: PTE, INV, HE.

Dependent variables	*unemployment rate model*			*flow model*		
	parameter estimation	*t-student statistics*	*p- value*	*parameter estimation*	*t-student statistics*	*p- value*
Intercept		3,813	0.000		0.446	0.656
GDP	-0.214	-2.102	0.038	-0.172	-2.096	0.038
TE	-0.116	-1.321	0.189	0.217	3,086	0.003
PTE	0.308	3.162	0.002	0.048	0.613	0.541
INV	-0.401	-3.925	0.000	0.319	3,882	0.000
HE	-0.413	-3.942	0.000	0.562	6,676	0.000
KIE	0.041	0.411	0.682	0.083	1,029	0.306
PANDA	-0.242	-2.345	0.021	-0.063	-0.763	0.447
R^2 corrected	0.215			0.493		
Tests of normality	Kolmogorov Smirnov p< 0.05	Shapiro -Wilk p = 0.00106		Kolmogorov Smirnov p > 0.20	Shapiro - Wilk p = 0.000063	
	not normally distributed			normally distributed		

Table 7. Regression parameter estimates for the unemployment rate and flows

The coefficient of determination was used when assessing the fit of model estimates to empirical data (Table 7). The determination coefficients (Correction R^2 =0.215 for the unemployment rate model and R^2 =0.493 for the flow model) indicate that the unemployment rate model allows to explain over 21%

of the variance of the dependent variable, and the flow rate model explains over 49% of the variance of the dependent variable.

Kolmogorov-Smirnov tests were used to verify the normality of the distribution of residuals and Shapiro-Wilk. In the case of the unemployment rate model, the p-value in the Shapiro-Wilk test (0.001) was less than the critical value (0.05). The p-value in the Kolmogorov-Smirnov test was less than the critical value (0.05), which indicates that the distribution of residuals is not normal, and that the model's functional form is incorrect. Other modelling methods can be used when linear regression is inappropriate for solving the problem. Decision trees are structures that make decisions based on the values of various features, dividing the data into smaller subsets until the appropriate level of detail is achieved. A random forest is an ensemble of multiple decision trees that work together to create a more stable and accurate model, counteracting the problem of overfitting. Neural networks, inspired by the structure of biological brains, consist of layers of neurons that process and transform input data. However, this study will present the regression analysis results for flows.

In the case of the flow model, the p-value in the Shapiro-Wilk test (0.00) was more significant than the critical value (0.05). The p-value in the Kolmogorov-Smirnov test was more significant than the critical value (0.05), so we can assume that the distribution of residuals is normal and that the model's functional form is correct. The analysis showed that the flow model is accurate, but the unemployment model cannot be considered correct. For the flow model, the variables PTE, INV, and HE significantly (at the significance level of 0.05) influence the estimation of the independent variable, and the obtained estimates are consistent with the assumed logic.

The study shows that the increase in these explanatory variables in the studied group of countries contributes to the rise in the rate of flows of people between employment and unemployment, which implies a more dynamic nature of unemployment and shorter periods of duration. Logarithms of the values of individual variables were modelled, so the obtained parameters have an elasticity interpretation. An increase in explanatory variables by 1% results in an increase in the flow intensity index by approximately 2.1 - 0.4%. The parameter estimates of the variables are consistent with the theoretical findings of economic theory. For example, an increase in the share of temporary employment by 1% results in an increase in the rate of people's flows between employment and unemployment by 0.217% in the studied group of countries. An increase in the share of investment in GDP (INV) by 1% results in an increase in the rate of people's flows between employment and unemployment by 3.19%. It also turns out that the share of people with higher education in the number of professionally active people (HE) results in an increase in the rate of people's flows between employment and unemployment by 5.62%.

6. CONCLUSIONS

The analyses show that the labour markets in the countries of Central and Eastern Europe in 2011-2022 differed in terms of unemployment rates and the dynamics of people's flows between labour market states, implying specific average periods of unemployment.

Comparative analyses of unemployment rates conducted for 2011-2022 indicate that the lowest unemployment rates occurred in the Czech Republic, Slovenia and Poland and the highest in Estonia, Croatia and Lithuania. Analogous comparative analyses of the dynamics of people flows between employment and unemployment showed that the highest dynamics occurred in Estonia and the lowest in Bulgaria and Romania. Unemployment in Estonia was, therefore, the most dynamic, meaning relatively short average periods of unemployment, while in Bulgaria and Romania, the unemployment phenomenon was the most stagnant, implying a high share of long-term unemployment.

Differences in unemployment between the surveyed countries were also confirmed by the taxonomic indicator of unemployment, which considers the total levels of unemployment rates and the levels of flow dynamics. In all country rankings for 2011-2022, the Czech Republic was in the leading position, while Croatia was in last place.

Unemployment in the Czech Republic is characterised by relatively low unemployment rates and the dynamic nature of unemployment, expressed in relatively short periods of its duration. The most difficult situation occurs in Croatia, as high unemployment rates accompany relatively long periods of unemployment.

The econometric analyses indicated the importance of factors determining unemployment rates and the dynamics of people's flows between unemployment and employment in the studied countries. The factors significantly influencing the increase in the dynamics of the flow of people in the labour market turned out to be an increase in the share of temporary employment, an increase in the share of part-time jobs, and an increase in investments in the economy.

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APPENDIX

VARIABLE	*GDP*	*ZT*	*ZNP*	*INV*	*WW*	*ZW*	*EPL*	*ARP*	*PANDAS*	*SB*	*HR*
GDP	1,000	-0.062	-0.014	-0.024	0.041	0.028	-0.623	-0.067	-0.129	1,000	-0.062
ZT	-0.062	1,000	-0.010	-0.420	0.011	-0.252	-0.075	0.066	0.083	-0.062	1,000
ZNP	-0.014	-0.010	1,000	0.325	0.470	0.283	-0.029	0.007	0.441	-0.014	-0.010
INV	-0.024	-0.420	0.325	1,000	-0.002	0.423	0.060	-0.244	0.278	-0.024	-0.420
WW	0.041	0.011	0.470	-0.002	1,000	0.461	0.113	-0.286	0.610	0.041	0.011
ZW	0.028	-0.252	0.283	0.423	0.461	1,000	0.116	-0.237	0.424	0.028	-0.252
EPL	-0.623	-0.075	-0.029	0.060	0.113	0.116	1,000	-0.175	0.118	-0.623	-0.075
ARP	-0.067	0.066	0.007	-0.244	-0.286	-0.237	-0.175	1,000	-0.395	-0.067	0.066
PANDAS	-0.129	0.083	0.441	0.278	0.610	0.424	0.118	-0.395	1,000	-0.129	0.083
SB	1,000	-0.062	-0.014	-0.024	0.041	0.028	-0.623	-0.067	-0.129	1,000	-0.062
HR	-0.062	1,000	-0.010	-0.420	0.011	-0.252	-0.075	0.066	0.083	-0.062	1,000

Table 8. Correlation matrix

Source: own study in STATISTICA

VARIABLES	*N important*	*Mean*	*Dev . std*	*Co. decreased*
GDP	132	103.08	3.18	3.08
ZT	132	8.63	7.15	82.92
ZNP	132	7.21	2.75	38.16
INV	132	21.93	3.18	14.50
WW	132	40.63	7.26	17.87
ZW	132	31.36	2.27	7.24
SB	132	7.91	3.50	44.29
HR	132	57.91	23/03	39.77

Table 9. Selected descriptive statistics of explanatory variables

Source: own study in STATISTICA