Modeling of Structural Changes in the Employment as the Direction of Economic Security Risk Management

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Abstract

In the context of economic security development, attention is focused on solving complex theoretical and applied problems that describe the relationships between various economic objects. In terms of building strategies for managing economic security, a mathematical model of economic security risks has been developed and analyzed. The risks of economic security at the regional and state levels are identified: the risks of employment transformation associated with the aging of the population, the risk of maintaining a significant share of inefficient jobs, the risk of limited access of human capital carriers to productive jobs, the risk of volatility of labor income, the risk of growth in educational and qualification inconsistency of human capital with the needs of the economy. An economic-mathematical model of structural transformations in the sphere of employment of the population depending on the dynamics of the growth of the level of employment of the population in the main sectors of the economy (agriculture, forestry, and fisheries; industry; construction) based on statistical data of the Kyiv region was built and researched. Attention is focused on the selection procedure of factor variables that should be a part of the econometric model, which is one of the key aspects that are studied while constructing a multivariate regression equation. The coefficients of correlation, elasticity, and the average value of the relative error of approximation were calculated and analyzed, and the built model was tested for statistical significance using the Fisher test. Based on the results of the analysis, the model is adequate, statistically significant, and suitable for point and interval forecasting. The article identifies the main threats to the economic security of Ukraine: the mass migration of the population with higher education during the war, and the migration of children and youth, which in the period of post-war reconstruction will be manifested by a shortage of quantitative and qualitative characteristics of the workforce. The priorities for restoring Ukraine's macroeconomic security are indicated. A theoretical analysis of economic security in terms of various spheres of the economy was carried out, in particular, the threats to the macroeconomic security of Ukraine related to employment and the search for ways to overcome them were described in detail.

Keywords

Economic security, risks in the sphere of employment of population, labor market, employment of population, structural transformations in the sphere of employment, economic and mathematical modeling.

1. Introduction

In the context of the modern development of economic security, special attention is paid to the solution of complex theoretical and applied problems, which quantitatively and qualitatively describe the relationships between various economic objects. This necessitates the development and analysis of mathematical models of economic security risks, which are used to build economic security management strategies. These models usually include elements such as risk identification, risk probability analysis, loss assessment, construction of risk

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minimization strategies, and development of risk control methods. Different methods can be used to build mathematical models of economic security risks, such as statistical analysis, probability theory, decision-making theory, mathematical modeling and others.

The method of mathematical modeling is one of the most common methods of scientific knowledge. It is used to solve problems in economics, sociology, medicine, and applied sciences. Where the method of scientific observation and the method of the scientific experiment does not provide tangible results (due to the long duration of certain processes or phenomena under investigation, or the impossibility of conducting multi-scale experiments to ensure reliable results), the method of mathematical modeling comes to the rescue.

The use of mathematical modeling in various fields of science allows for deepening quantitative and qualitative analysis, expanding the scope of obtaining information, and speeding up mathematical calculations.

When studying socio-economic phenomena and processes that characterize one or another stage of the development of the market economy, it is necessary to deal with various mass phenomena, identify existing patterns, and establish directions for their development. The task of studying the quantitative aspects of mass phenomena and processes in an inextricable connection with their qualitative aspect is primarily solved by econometric modeling, which, with the help of its instrumental and theoretical apparatus, establishes cause-and-effect relationships in the studied economic systems to conduct their analysis, synthesis, diagnosing problems and finding ways to overcome them [1].

The main task of modeling is the development and analysis of mathematical models, which are represented by certain abstract mathematical relations (equations or systems of equations). The constructed mathematical model must satisfy several requirements: firstly, it must adequately reflect the process or phenomenon under investigation; secondly, to be as simple as possible. Even A. Einstein said: “Models should be as simple as possible, but not simpler.”

It is worth noting that mathematical models can be a useful tool for managing risks and developing effective strategies for managing economic security. However, it is important to remember that models do not always accurately reflect the real world, so it is important to evaluate them and critically evaluate their results.

2. Statement of the Problem and Relevance of the Research

The state of macroeconomic security during 2010–2019 (with the average value of the state of macroeconomic security assessment for this period at the level of 38% of the optimal value) was characterized as dangerous [2]. Macroeconomic disparities formed in previous periods, in particular, in the labor market, and in the structure of production, continued to restrain the economic development of the country.

The labor market, in turn, acts as the most specific subsystem of the economy and at the same time, its driving force determines the prospects for ensuring sustainable economic and innovative development, which are primarily related to the quality characteristics of the workforce and decent working conditions.

In recent years, fluctuating dynamics of the level of macroeconomic security have emerged. In particular, according to the results of 2019, the level of macroeconomic security increased by 6 percentage points up to 45% of the optimal value due to the implementation of the policy aimed at increasing the level of income of the population and the implementation of the inflation targeting policy by the National Bank of Ukraine. However, according to the results of the first half of 2020, the level of macroeconomic security decreased by 6 percentage points up to 39% compared to the corresponding period in 2019, which indicates the preservation of significant risks of destabilization of the macro-environment [2] and, in particular, the labor market.

Among the theoretical and practical aspects of the study of the various aspects of economic security, it is worth noting the works of O. Tymoshenko (methodical approaches to assessing the level of economic security of the state) [3], A. Pilko (modeling the process of assessing the level of economic security of the region) [4], Z. Varnaliya (research of problems and priorities of strengthening national economic security) [5], V. Sazonova (conditions for ensuring economic security) [6], R. Snishchenko (research of problems of economic security of economic entities in conditions of instability) [7], O. Komelin and S. Onyshchenko (methodology of evaluation and determination of strategic guidelines for ensuring economic security) [8] and others. In most scientific works, threats to economic security are considered in various spheres of the economy. However, today the study

of employment-related threats to the macroeconomic security of Ukraine and the search for ways to overcome them is becoming increasingly relevant.

Among the scientists who studied the interrelationships of structural shifts of economies at the macro- and meso-levels and employment of the population, it is worth highlighting; V. Bliznyuk (study of educational and qualification disparities in the regional labor market of Ukraine), [9] T. Vasyltsiva (determination of structural disparities and imbalances of the labor market of the regions of the Carpathian region of Ukraine in war conditions) [10], L. Ilyich (modeling of structural transformations in the field of population employment) [11]; O. Novikova and L. Shamileva (forecasting changes in the labor sphere during digitalization of the economy according to inertial and target scenarios of the development of Ukraine) [12] Yu. Marshavina (modeling of the relationship between population employment and the most significant factors of demand) [13]; V. Reutova (determination of regional disparities based on structural changes in the economy) [14].

Modeling the risks of economic security allows you to assess possible risks and prepare for possible negative consequences. Such models help to predict possible risks, analyze their impact on the economy, and develop risk management strategies.

Risk modeling is a tool for managing risks and ensuring economic security at various levels: from an individual enterprise to the state level. Such models can help avoid financial losses, and reduce the risks of industrial accidents and other negative events that can harm the economy and society in general [15–17].

In addition, risk models make it possible to ensure a more efficient use of resources, increase the level of competitiveness and reduce the costs of risk management. Considering the complexity of the modern economy and the threats that may appear, risk models are an important tool for ensuring the stability and security of the economy.

The process of modeling the risks of economic security may include various factors that affect economic security. These factors may be:

Economic indicators: such as GDP, inflation, unemployment, the exchange rate, etc.

Political factors: such as the stability of the government, the legal system, international relations, etc.

Social factors: such as the demographic situation, level of education, level of poverty, cultural and religious factors, etc.

Natural factors: such as natural disasters, climate change, environmental problems, etc.

Technological factors: such as innovations, changes in technological approaches, growth in the number of cyber-attacks, etc.

These factors can be taken into account when building a mathematical model of economic security risks to assess the level of risk and develop risk management strategies.

Let's focus on social factors in more detail. Because a result of modern transformations of the labor market and aggravation of the asynchrony of its situation, there is a contradictory and uneven nature of its development, which is manifested in the imperfection of certain elements of the market mechanism and leads to certain risks at both the regional and state levels, in particular:

1. Risks of employment transformation associated with the aging of the population, deterioration of its age structure, and reduction of the total number. Over the past two centuries, our country has had one of the highest rates of population aging among European countries, which affected the quality of human capital. Now the situation is even more aggravated because of the war and the drain of talent.
2. The risk of maintaining a significant share of inefficient workplaces. The destruction of infrastructure, the slowdown in production rates and the rate of structural restructuring of the economy, limited investment opportunities, and the weak motivation of employers to create new jobs hurt the processes of forming demand for labor, expressed in the number of jobs. Perpetuation of inefficient jobs, which in turn stimulates the supply of low-quality human capital and unproductive employment.
3. The risk of limited access of human capital carriers to productive workplaces, primarily affects young people and the elderly, less qualified workers, and people living in regions with limited employment opportunities. In Ukraine, education, work skills, and personal qualities are less important for employment and maintaining a workplace than personal connections and social status. Since during the economic reform, job creation took place mainly in the informal sector and in sectors with lower labor productivity, such jobs are mainly "survival jobs" and as a result

cannot contribute to the long-term development of the economy and the improvement of the quality of human capital in the future.

4. The risk of volatility of labor income is most often caused by endogenous factors that lead to fluctuations in labor demand, changes in workplace and profession preferences, forced transition to part-time employment, permanent or labor migration, etc. Often, in these cases, the so-called poverty of the working people arises. First of all, this is characteristic of situations when employees, due to various reasons, do not receive a decent reward for their work; their wages are lower than the established minimum standard even under full employment conditions.

5. The risk of growing educational and qualification mismatch of human capital with the needs of the economy. In Ukraine, 26.6% of employed people aged 15–70 are characterized by excess education and are mainly concentrated in agriculture, forestry and fisheries, construction, temporary accommodation and catering, wholesale and retail trade, transport and communications, and workplaces, which do not require high qualifications. In this regard, the fact that overeducated workers in these types of economic activity do not fully realize their potential and gradually lose some of the competencies that are not required by their workplaces causes concern. This situation revolves around not only the aging of competencies but also the fact that a more qualified labor force gradually displaces a less qualified one from the economy. There is an erosion of human capital, which further exacerbates the social tension in the labor market. If these trends persist, there will be no incentive for employers to raise wages, since they will be able to hire people with a greater skill set for the same money as a sufficiently skilled workforce.

The problem of the mismatch of qualifications in Ukraine is deepened by the existence in some cases of unjustifiably inflated requirements for job applicants, which encourages them to constantly improve their educational level, while in society, meanwhile, there is a growing shortage of vacancies that do not require higher education. The shortage of qualified workers in professions that have a special demand in the labor market ultimately leads to the impossibility of high-quality staffing of enterprises with the necessary human capital [18].

The educational and qualification mismatch of human capital hurts production efficiency, causes staff turnover and talent outflow, increases the cost of finding the right specialist, and prevents the introduction of new technologies. At the macro level, these phenomena are manifested in the spread of unemployment, shadow employment, and economic inactivity, loss of human capital, which in aggregate negatively affects the well-being of the country.

Considering the current situation in Ukraine, the problems of macroeconomic security, the search for methods and ways to protect the economy of Ukraine is more relevant than ever and requires a clear organization of scientific research aimed at identifying challenges and threats in the field of employment and their minimization in the field of economic security. The results of such studies will form the basis for the creation of an effectively functioning system of strategic planning and forecasting, capable of adequately responding to existing and future risks.

The purpose of the article is to identify the risks of transformation of the labor market both at the regional and state levels, to develop an economic-mathematical model of structural transformations in the sphere of employment of the population depending on the dynamics of the growth of the employment level of the population in the main sectors of the economy (agriculture, forestry, and fisheries; industry; construction).

Kyiv region was taken as the object of the study, a region whose economic structure is dominated by construction, real estate operations, and financial services, but the share of industrial production, agro-industrial complex, and food industry is also significant.

The research is based on the use of economic-mathematical modeling methods using Excel and Mathcad application packages, including methods of correlation analysis, and tabular and graphic analysis methods. Correlation analysis makes it possible to determine the existence of dependence between two variables, for example, between employment in a certain sector of the economy and the total employment of the population in the region. If the correlation between these variables is strong, then it can be argued that employment in this sector of the economy has an impact on total employment in the region. Regression analysis can be used for a more accurate analysis of dependence. Regression analysis makes it possible to determine how much variable

employment in a certain sector of the economy affects the change in total employment in the region. At the same time, it is possible to take into account other factors that can also affect the total employment, for example, demographic and economic indicators of the region.

3. Research Results

The purpose of building an economic-mathematical model is to study the dynamics of the employment level of the population aged 15 to 70 from the dynamics of the number of the employed population by types of economic activity in Kyiv and the Kyiv region: agriculture, forestry, and fishing (Code according to KVED–2010/Code NACE, Rev .2-A), industry (Code according to KVED-2010/Code NACE, Rev.2-B+C+D+E), construction (Code according to KVED-2010/Code NACE, Rev.2-F). The statistical data were taken from the statistical information of the State Statistics Service of Ukraine [19] and transformed into the dynamics of changes in indicators from 2005 to 2020 with the help of mathematical calculations. This amount of data is sufficient for building an econometric model and using Fisher and Student statistical criteria when analyzing the constructed model for statistical significance.

When studying many economic processes, it is necessary to establish and evaluate the dependence of some economic indicator on one or more other indicators. Any economic indicators are usually influenced by random factors, and therefore, from a mathematical point of view, are interpreted as random variables. Strict functional dependence is rarely realized in the economy. The so-called statistical dependence is more often observed when a change in one random variable leads to a change in the law of the probability distribution of another.

Analyzing a statistical series of data, we note that the construction of econometric models requires the presence of stable interrelationships of correlated variables. Periods of economic and political upheavals, and as a result, demographic and social ones, disrupt the stable dynamics of processes and phenomena (which is reflected in the diagram of the dynamics of changes in employment of the population by types of activity by sharp "failures" of certain indicators). This, in turn, although it affects the quality of the built model in the part related to the study of adequacy and calculation of the value of the relative error, does not violate the objectivity of the obtained results regarding the study of the statistical significance of the model as a whole.

The initial stage for the construction of an econometric model is the identification of variables [20]. According to the results of identification, we get: Y is the rate of growth of the employed population; X_1 is the growth rate of the employed population in agriculture, forestry, and fisheries; X_2 is the growth rate of the employed population in the industry; X_3 is the growth rate of the employed population in construction (Table 1.).

Table 1

The dynamics of changes in employment of the population by types of economic activity

	Y	X_1	X_2	X_3
2005	1	1	1	1
2006	1	1,04	0,99	1,05
2007	1	0,85	0,97	1,03
2008	1	0,84	0,98	1
2009	0,95	0,93	0,92	0,83
2010	1	0,84	0,98	0,91
2011	1	0,99	0,98	0,93
2012	1	1	1,01	0,96
2013	1	0,9	1,01	0,88
2014	0,47	0,88	0,83	0,54
2015	0,94	0,98	0,93	0,94
2016	1	1,03	1	0,99
2017	0,91	0,94	1	1,05
2018	1,04	1	1,01	1,11
2019	1,04	0,98	0,98	1,07
2020	1	0,93	1,03	1,03

The diagrams show the dynamics of changes in employment by selected types of activity in comparison to total employment in the region (**Error! Reference source not found.**–**Error! Reference source not found.**).

Fig. 1 shows the dynamics of changes in employment by agriculture, forestry, and fisheries in comparison to total employment in the region.

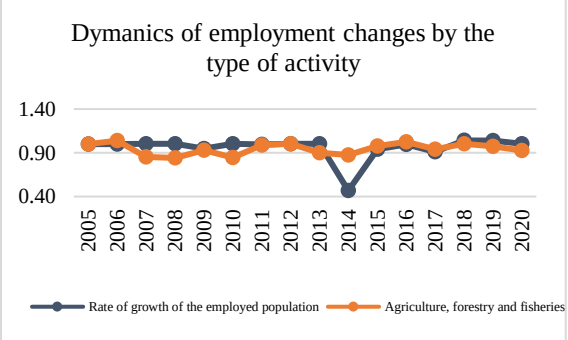

Figure 1: The dynamics of changes in employment of the population by types of activity from 2005 to 2020

Fig. 2 shows the dynamics of changes in employment by industry in comparison to total employment in the region.

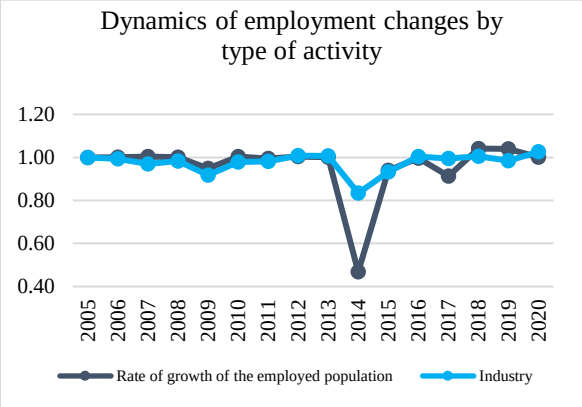

Figure 2: The dynamics of changes in employment of the population by types of activity from 2005 to 2020

Fig. 3 shows the dynamics of changes in employment by construction in comparison to total employment in the region.

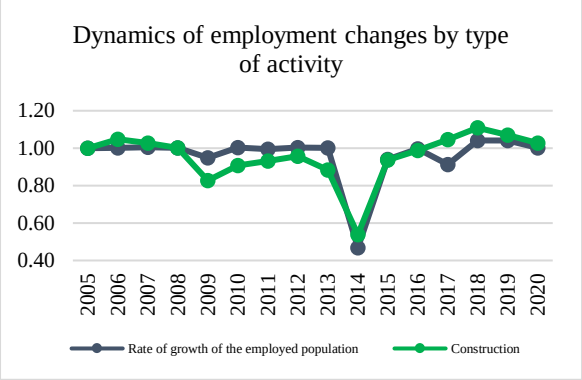

Figure 3: The dynamics of changes in employment of the population by types of activity from 2005 to 2020

No less interesting seems to be the comparative characteristics of the dynamics of industry employment by the relevant types of activity, namely, in agriculture, forestry, and fishing; in the industry; of construction (**Error! Reference source not found.**).

The issue of selection of factor variables that should be included in the model is one of the key aspects that are investigated when building a multivariate regression equation.

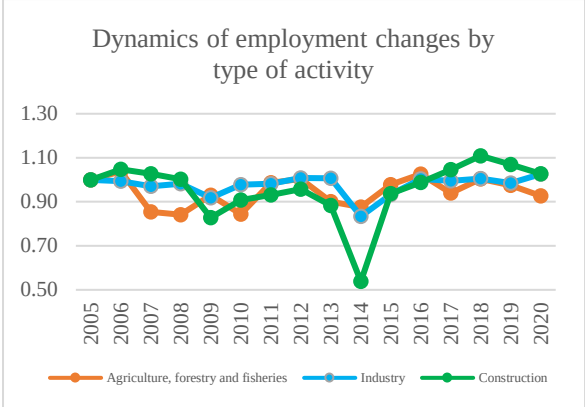

Figure 4: The dynamics of changes in employment of the population by types of activity from 2005 to 2020

All the selected factor variables should be quantitatively measured and satisfy several characteristics, namely: have high variability; strongly correlated with the outcome variable; weakly correlated with each other; be highly correlated with variables that are not used in the model as factor variables but are related to the outcome variable. To check the density of the connection between the resulting and the corresponding factor variables; between the factor variables appearing in the model under study, we calculate the correlation coefficients:

$$r_j = \frac{\overline{x_j y} - \bar{x}_j \cdot \bar{y}}{\sqrt{\overline{y^2} - (\bar{y})^2} \cdot \sqrt{\overline{x_j{}^2} - (\bar{x}_j)^2}}, \quad (1)$$

and

$$r_{kj} = \frac{\overline{x_k x_j} - \bar{x}_k \cdot \bar{x}_j}{\sqrt{\overline{x_k{}^2} - (\bar{x}_k)^2} \cdot \sqrt{\overline{x_j{}^2} - (\bar{x}_j)^2}}, \quad (2)$$

where $k, j = \overline{1, n}$.

The calculated values of the correlation coefficients are presented in Fig. 5, where we can note the strength of the correlation: X_1 is the rate of growth of the employed population in agriculture, forestry, and fishing with the resulting variable Y as 0.29; X_2 is the rate of growth of the employed population in the industry with the effective variable Y as 0.85; X_3 is the rate of growth of the employed population in construction with the resulting variable Y as 0.86. It is worth noting that the condition that the factor variables should be weakly correlated with each other is observed. The next step of the research will be to build a model.

	Y	X_1	X_2	X_3
Y	1			
X_1	0,28837	1		
X_2	0,85337	0,34207	1	
X_3	0,86112	0,38049	0,84329	1

Figure 5: Results of calculations of correlation coefficients.

To build an econometric model, we will use the MS Excel data analysis package add-on, the Regression tool, which performs calculations using the method of least squares.

SUMMARY OUTPUT				
Regression Statistics				
Multiple R	0,894593992			
R Square	0,80029841			
Adjusted R Square	0,750373013			
Standard Error	0,067620881			
Observations	16			
ANOVA				
	df	*SS*	*MS*	*F*
Regression	3	0,219893975	0,073297992	16,0298856
Residual	12	0,054871003	0,004572584	
Total	15	0,274764978		
	Coefficients	*Standard Error*	*t Stat*	*P-value*
Intercept	-0,671574237	0,53356249	-1,258660887	0,23208924
X Variable 1	-0,116794652	0,286370113	-0,407845115	0,690569928
X Variable 2	1,280232506	0,691913706	1,85027771	0,089037808
X Variable 3	0,514588038	0,24731909	2,08066445	0,059552761

Figure 6: Calculation of regression-correlation analysis parameters

As a result of the calculations, the economic-mathematical model will take the form:

$$\hat{Y} = -0.67 - 0.12X_1 + 1.28X_2 + 0.51X_3 \quad (3)$$

The correlation coefficient, which characterizes the density of the linear relationship between all independent variables X and the resulting variable Y, is equal to 0.89. Since the value of the correlation coefficient is close to unity, this confirms a fairly close relationship between the factors and the resulting variable, the change in factor indicators (X_1 is the rate of growth of the employed population in agriculture, forestry, and fishing; X_2 is the rate of growth of the employed population in the industry; the rate of growth of the employed population in the industry; X_3 is the rate of growth of the employed population in construction) affects $R^2 = 0.98^2 \cdot 100\% = 80\%$ on the change of the performance indicator, and in the studied model it is the growth rate of population employment.

The built model is adequate, which is evidenced by the average value of the relative error of the estimated regression values, which are within 10%. For the Kyiv region, the relative error is equal to $\overline{A} = \frac{1}{n}\sum_n \left|\frac{u_i}{y_i}\right| \cdot 100\% = 5\%$, and it is statistically significant, as evidenced by the comparison of the calculated values using the Fisher test (F_{test} = 16.02, F_{table}=3.49).

One of the important characteristics for the interpretation of the econometric model is the calculation of the coefficient of elasticity for each of the factors: $E_i = \hat{a}_i \cdot \frac{\overline{x_i}}{\overline{y_i}}, (i = \overline{1,3})$ and general elasticity E: $E = \sum_{i=1}^{3} E_i$, which shows how the result will change with a simultaneous change of all factors by 1%. So, according to the calculations E_1 = –0.11, E_2 = 1.3, E_3 = 0.51, E = 1.7. As we can see from the results of the calculations, if all the selected factors increase by 1%, the dynamics of the rate of general employment of the population will increase by 1.7%.

Analyzing the built model about the found parameter estimates, it is worth noting that the determining factors that affect the dynamics of employment growth in the studied region are industry (a_2 = 1.28) and construction (a_3 = 0.51). The negative coefficient of the regression model (a_1 = –0.12) means that an increase in employment in the sector of agriculture, forestry, and fishing leads to a decrease in total employment in the region. Such results may be due, for example, to structural changes in the economy of the region, when one of the sectors of the economy, for our study, is the sector of agriculture, forestry, and fisheries, replaces another or other sectors and, as a result, there is a shift in employment. But, of course, before making conclusions about the reasons for the employment shift, it is necessary to carry out a more thorough study in this direction.

Summing up the above, we note that the modern labor market of Ukraine, which is a component of macroeconomic security, functions in conditions of shocks caused not only by the globalization of the economy but also by the complex realities of the Ukrainian-Russian war. The loss of part of Ukrainian territories, the property of legal entities and individuals, and the destruction of critical and social infrastructure led to a drop in production, an increase in inflation, a reduction in the economic activity of the population, a deepening of poverty problems, etc.

Fleeing from the war, a large part of the population is forced to seek shelter for themselves and their loved ones in other regions, and in some places even abroad, which increases the pressure

on jobs. The Ukrainian-Russian war became a shock not only for national, but also for global security. According to estimates of the UN Refugee Agency, as of the beginning of June 2022, about 7 million people have left Ukraine since the beginning of the full-scale war. Two-thirds of them have a higher education, and 49% were employed in occupations that require high qualifications. From the end of April, Ukrainians began to return from their countries of temporary stay and, according to the UN, 2.1 million people have already done so [21].

Mass migration of the population with higher education (more than 60–70% of the total population of migrants according to the Institute of Demography and Social Research named after M. V. Ptukh of the National Academy of Sciences of Ukraine [22]), the drain of talents and erosion of human capital is becoming a serious threat to the economic security of Ukraine, which "failed to receive part of the potential added value and revenues of the budget and at the same time had to spend significant funds on unemployment assistance and financial support for low-income families of forced migrants. According to the data of the National System for Monitoring the Situation with Internally Displaced Persons (IDPs), the employment of this category of persons as of March 2021 was 49%, while that of the entire population of Ukraine aged 15–70 was 56%." [23]. At the moment, it is not known for certain how many people have left, what their age and level of education are, who among them will return, and who no longer considers such a prospect for themselves. The migration of children and young people is no less alarming fact, which will be felt already in the immediate period of post-war reconstruction and will certainly manifest itself in the shortage of quantitative and qualitative characteristics of the workforce. Therefore, the return of migrants, ensuring effective mechanisms for reintegration and employment is one of the priorities in the context of macroeconomic security.

4. Conclusions

According to the estimates of the World Bank, 60–80% of the GDP of developed countries is not provided by physical or financial capital, but rather by human capital, that is, the population, its health, education, and qualifications play a decisive role. One of the important factors in supporting the population and overcoming threats to social security in wartime is jobs. They contribute to the development of the economy, increase the purchasing power of the population, and are a reliable tool to overcome poverty [24]. The pandemic and external aggression have increased risks and uncertainties, leading to the destruction of labor market institutions and their effective functioning. Only a labor market that promotes people's economic activity and facilitates the redistribution of workers between workplaces will be able to cope with today's challenges. Effective use of available human capital, solving the problem of unemployment among internally displaced workers, and stable protection of the most vulnerable population groups—are the provisions that should be included in the strategy of labor market recovery.

Information on the employment status of the population is the basis for creating and implementing an effective strategy for the socio-economic development of a particular region and the state in general. In this regard, the evaluation and analysis of the employment of the population acquire significant importance, which requires the further application of statistical research methods to determine the state and patterns of development of the employment of the population in regional and macroeconomic aspects.

The obtained estimates of the parameters of the built model ($a_2 = 1.28$ and $a_3 = 0.51$) indicate that the determining factors that affect the dynamics of the growth of the level of employment in the studied region are, respectively, industry and construction.

The work analyzes the dynamics of structural changes in the sphere of population employment by types of activity. Based on the analysis of the labor market, a clear positive linear relationship was established between the dynamics of population employment and population employment in agriculture, forestry, fishing, industry, and construction. The found elasticity coefficient indicates that a 1% increase in the rate of population employment in the sectors of the economy related to agriculture, industry, and construction will lead to a 1.7% increase in the overall employment dynamics of the Kyiv region population. The obtained results are consistent with the data of the State Employment Service [25], according to which, as of June 2022, agriculture, food industry, and construction are among the areas most in need of workers both in the region of Kyiv region and in Ukraine in general. Obviously, the labor market correlates with the sectors of the economy that provide the

basic needs of the population in those territories where hostilities are not taking place.

The constructed model is adequate (the relative error does not exceed 5%) and statistically significant in general (according to Fisher's test), therefore suitable for point and interval forecasts.

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