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FORECASTING THE EFFICIENCY OF LABOR RESOURCES OF UKRAINE

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The article is devoted to the study of issues related to forecasting the efficiency of labor resources in Ukraine. The relevance of the work is explained by the constant change in the conditions of the national and global economic situation, which determines the need to adapt human resource management strategies to ensure the country's sustainability and competitiveness. It is especially important to consider the impact of factors such as technological changes, demographic and educational transformations, which can significantly affect the quality and quantity of labor resources. The article analyzes the dynamics of macroeconomic indicators of labor resources use over the past eleven years, in particular: gross domestic product, labor productivity, unemployment, employment, and wages. It is established that during this period the country faced various challenges that significantly affected the dynamics of labor resources. In particular, the analysis shows that in 2014 and 2015 there was a significant decline in gross domestic product and labor productivity. This was due to economic difficulties caused by political instability and military operations in the east of the country. From 2016 to 2021, the consequences of the pandemic were gradually overcome, and economic stability was restored. To analyze the dynamics and forecast labor productivity as an indicator of the efficiency of the country's labor resources, the authors have built several trend models. It has been established that the models are of high quality and consider the main regularities.

ПРОГНОЗУВАННЯ ЕФЕКТИВНОСТІ ТРУДОВИХ РЕСУРСІВ УКРАЇНИ

Лось В.О., Макаренко О.І., Лось О.В.*Запорізький національний університет**Україна, 69600, м. Запоріжжя, вул. Жуковського, 66***Ключові слова:**

прогнозування, динаміка, трудові ресурси, ефективність, продуктивність праці, зайнятість

Стаття присвячена дослідженню питань щодо прогнозування ефективності трудових ресурсів України. Актуальність роботи пояснюється постійною зміною умов національної та світової економічної ситуації, що визначає необхідність адаптації стратегій управління трудовими ресурсами для забезпечення стійкості та конкурентоспроможності країни. Особливо важливим є врахування впливу факторів, таких як технологічні зміни, демографічні та освітні трансформації, які можуть значно вплинути на якість та кількість трудових ресурсів. Проаналізовано динаміку макроекономічних показників використання трудових ресурсів за останні одинадцять років, зокрема: валовий внутрішній продукт, продуктивність праці, рівень безробіття, зайнятість та заробітна плата. Встановлено, що за цей період країна стикалася з різноманітними викликами, які суттєво вплинули на динаміку трудових ресурсів. Зокрема, аналіз свідчить про те, що в 2014 та 2015 роках спостерігалось значне скорочення валового внутрішнього продукту та продуктивності праці. Це обумовлено економічними труднощами, які виникли внаслідок політичної нестабільності та військовими діями на сході країни. З 2016 року по 2021 рік відбувалося поступове подолання наслідків пандемії та відновлення економічної стабільності. З метою аналізу динаміки та прогнозування

продуктивності праці, як показника ефективності трудових ресурсів країни, авторами побудовано ряд трендових моделей. Встановлено, що побудовані моделі є якісними і враховують основні закономірності та тенденції в динаміці продуктивності праці. На основі трендових моделей розроблено прогноз на наступний період та визначимо помилку та точність прогнозів. Помилки прогнозів менші або дорівнюють 10 %, що свідчить про високу точність побудованих прогнозів.

Statement of the problem

Human resources are one of the most valuable assets of any country. Their efficient and rational use not only enhances the competitiveness of the national economy, but also ensures social stability, decent living standards and equal opportunities for all citizens. The problem of efficient use of labor resources is an important challenge for the development of any country. Even though labor resources are one of the most valuable assets, their effective use requires attention to various aspects, such as labor market development, labor productivity, and others. This problem becomes particularly relevant in the context of ensuring not only economic growth but also social stability and high living standards.

Analysis of recent studies and publications

The study of issues related to the assessment and forecasting of the efficiency of labor resources use is covered in many scientific works of both domestic and foreign scientists. N. Mazur [1] systematized the basic principles and approaches to assessing labor potential and diagnosed the effectiveness of its use. However, the system of criterion indicators of efficiency of labor potential use is not sufficiently substantiated.

S.P. Koval and D.V. Bida in their work [2] investigated the key aspects of the problem of efficient use of labor resources in Ukraine. The authors analyzed the concepts related to labor resources, such as working capacity, economic activity, and employment rate, and put forward proposals for optimizing their use in the labor market.

I.O. Irtishcheva and I.I. Dubinska in their work [3] considered regional labor markets and analyzed changes in the structure of employment. They formed a system of factors that characterize the development of labor resources and built a factor model. However, they did not consider the issue of assessing the efficiency of labor resources use.

Paper [4] considers a methodological approach to assessing the efficiency of the enterprise's labor resources. However, this approach does not consider the impact of macroeconomic indicators that also affect the efficiency of labor resources. Whereas O.O. Mnyshenko [5] studied the factors that affect the economic result due to increased labor productivity. She found that the economic result of productivity growth is directly correlated with two factors: a change in the volume of products manufactured or work performed and a change in the number of employees. Study [6] assessed the state of labor resources in Ukraine, analyzed labor market trends, and estimated the impact on the efficiency of economic activity of the state and society as a whole. Scientists A.V. Zhavoronok and

N.I. Kolesnikova [7] studied labor resources and evaluated their effective use. The authors also defined the theoretical foundations of the concept of labor resources and analyzed the dynamics of their composition. However, issues related to the estimation of labor resources efficiency require a more thorough study.

Therefore, because of the analysis of literature sources, it was found that many problematic issues related to the assessment of the efficiency of labor resources remain unresolved.

Objectives of the article

The article is aimed at analyzing the dynamics of a few macroeconomic indicators of labor resources use in Ukraine. Also, to forecast labor productivity as an indicator resulting from the economic activity of labor resources.

The main material of the research

Labor resources not only ensure the production of goods and services, but also affect the dynamics of the country's socio-economic development, determining the growth potential. A country's availability of the necessary labor resources determines its ability to innovate, compete and develop sustainably, as a high-quality and skilled workforce can contribute to productivity and the development of new technologies, which is the basis for the prosperity of any national economy. The efficiency of the labor force depends on several key factors, such as the education and skills of the workforce, access to infrastructure, technological level, labor market conditions, regulatory policy, and social conditions. If these aspects are optimally considered and supported in a country, labor resources can become a powerful source of economic growth and development.

In this study, labor resources are defined as the economically active, able-bodied part of the population that has the physical and intellectual abilities to participate in labor activity and produce material goods and services. Various macroeconomic indicators are used to assess the efficiency of the country's labor force, including gross domestic product (GDP), labor productivity, unemployment, employment, wages, etc. Analyzing the dynamics of these indicators allows us to determine how efficiently a country uses its labor resources and helps to improve its employment and labor force development policies. These indicators, according to the State Statistics Service of Ukraine [8] for the period from 2012 to 2022, are presented in Table 1.

An analysis of GDP dynamics over the period under study suggests that over the past eleven years, GDP has declined by 8.7 %. In addition, in 2014 and 2015, there was a significant decline in GDP by 28.1 % and 31.3 %, respectively.

Table 1 – Dynamics of macroeconomic indicators of labor resources utilization in Ukraine, 2012–2022

Year	GDP, mln. U.S. DOLLARS	Employed population, million people	Unemployed population, million people	Average monthly salary, UAH.	Labor productivity
2012	175781	19,26	1,59	3041,00	9126,08
2013	183310	19,31	1,51	3282,00	9490,94
2014	131805	18,07	1,85	3480,00	7292,80
2015	90615	16,44	1,65	4195,00	5510,79
2016	93270	16,28	1,68	5183,00	5730,21
2017	112154	16,16	1,70	7104,00	6941,77
2018	130832	16,36	1,58	8865,00	7996,63
2019	153781	16,58	1,49	10496,82	9276,04
2020	155582	15,92	1,67	11591,00	9775,62
2021	199770	15,61	1,57	12153,38	12797,57
2022	160500	15,39	1,55	13312,10	10430,75

Source: compiled by the authors based on [8]

respectively. This was due to economic difficulties caused by a combination of factors, including political instability, the annexation of Crimea and military operations in the east of the country. This, in turn, has led to a significant reduction in investment, lower exports and increased overall business risk. As a result of the hostilities, the country experienced a significant decline in production, particularly in the metallurgical and mining industries. This led to a 22.3 % increase in unemployment in 2014, which affected consumer activity and the overall level of economic activity in the country. From 2016 to 2021, there was a gradual increase in GDP, with the growth rate of 1.2 % in 2020 alone, which was caused by the significant impact of the COVID-19 pandemic on the economy. In 2020, the domestic economy faced significant challenges related to quarantine measures, lockdowns, and restrictions, which led to a decline in economic activity, disruption of global supply chains, and a decrease in the production of goods and services in various sectors of economic activity, which affected GDP growth in many countries, including Ukraine. Since 2021, there has been a gradual economic recovery, with GDP growing by 28.4 % compared to 2020, which is 13.6 % more than in 2012, indicating a gradual overcoming of the pandemic and restoration of economic stability. The outbreak of active hostilities on the territory of our country had a negative impact on the economy and, as a result, GDP decreased by 19.7 % in 2022.

The employed population decreased by an average of 2.2 % annually during the analyzed period. In 2022, the employed population decreased by 1.4 % compared to 2021. The growth of the employed can be traced only in 2018 and 2019 at the level of 1.3 %. The decline in the employed population in Ukraine is due to various factors, such as economic difficulties, structural changes in the employment sector, and the impact of external factors.

The dynamics of the unemployed population is fluctuating. The maximum number of unemployed people in the study period was observed in 2014 and 2020. This is primarily due to the hostilities in the east of the country and the COVID-19 pandemic, which resulted in the closure of businesses, a decrease in the number of jobs in the conflict zone, and general economic instability.

The average monthly salary in Ukraine increased 4.3 times during the analyzed period and grew by an average of 14.37 % annually. However, this growth does not indicate an improvement in the living standards of the population due to significant inflationary pressures and rising prices for consumer goods and services. Although the average monthly salary is increasing, inflation and economic factors affect its purchasing power, reducing the real income of the population.

The above-analyzed indicators of labor resources efficiency characterize them from different angles, in particular: employment and unemployment allow assessing the movement of labor resources in the economic system; average wages and incomes determine the consumption capabilities of labor resources. However, according to the authors, these indicators indirectly affect the efficiency of labor resources. In general terms, efficiency is the ratio of the result of activity to the costs. The result of the economic activity of labor resources is labor productivity, so the efficiency of the country's labor resources can be assessed as the achievement of the best result (output, i.e. GDP) using the least labor costs. Given this statement, let us analyze the dynamics of labor productivity in Ukraine in more detail.

The time series of labor productivity and its growth rate for the period from 2012 to 2022 in Ukraine is shown in Fig 1. The dynamics of labor productivity is fluctuating, which is a consequence of such economic factors as: structural changes in the country's economic system (e.g., changes in the structure of industry, the impact of technological innovations, external economic conditions, and other factors).

As can be seen from Fig. 1, labor productivity in 2022 decreased by 18.5 % compared to 2021. In general, over the study period, productivity grew by an average of 3.1 % annually. Thus, in 2022, compared to 2012, the analyzed indicator increased by 1.14 times. The maximum growth in labor productivity occurred in 2017 and 2021 by 21.1 % and 30.9 %, respectively.

It is worth noting that in 2014, the negative trends in macroeconomic indicators are also due to the fact that the State Statistics Service of Ukraine provides statistical information excluding the temporarily occupied territory

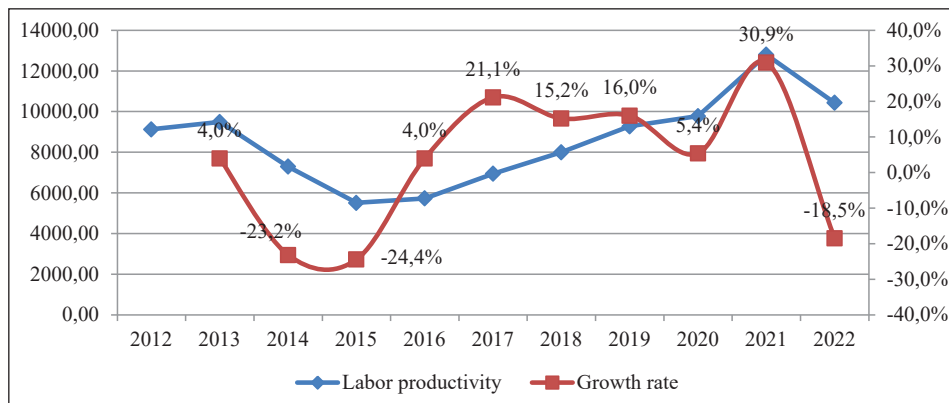


Figure 1 – Labor productivity dynamics and growth rates in Ukraine, 2012–2022
Source: built by the authors based on [8]

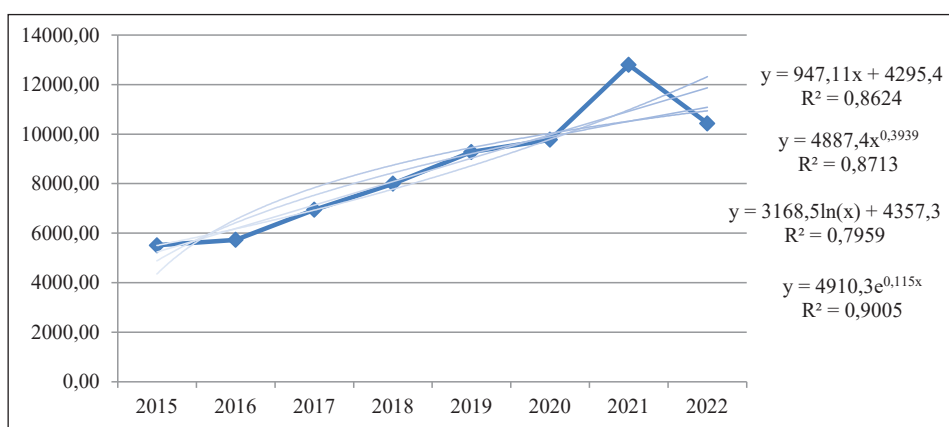


Figure 2 – Trend models of labor productivity dynamics in Ukraine
Source: calculated by the authors

of the Autonomous Republic of Crimea, the city of Sevastopol and parts of Donetsk and Luhansk regions, so the authors chose the time interval from 2015 to 2022 to analyze the dynamics of labor productivity.

In order to analyze the dynamics and forecast labor productivity in Ukraine, the authors have built trend models, namely linear, power, logarithmic, and exponential (Fig. 2). All the models are of high quality and describe more than 79 % of the original data. Therefore, it can be stated that they effectively take into account the main patterns and trends in the dynamics of labor productivity.

The overall adequacy of these models to the data, which is more than 79 %, confirms their ability to accurately describe and predict the dynamics of labor productivity.

This level of explained variability indicates that the built models are well adapted to the peculiarities of the source data and reflect the main regularities of the economic process. Therefore, on the basis of the built models, we will develop a forecast for the next period and determine the error and accuracy of the forecast, the results are shown in Table 2.

Analyzing the results (Table 2), we can conclude that all models are of high quality. The values of the absolute forecast errors are less than or equal to 10 %, which indicates the high accuracy of the forecasts. The absolute forecast error of the exponential model is minimal and amounts to 4.84 %, so this model is chosen to develop the forecast for the next period. Thus, in 2023, labor

Table 2 – Results of labor productivity forecasting

Type of model	Coefficient of determination	Forecast error (MAPE)	Labor productivity forecast for 2023
$y = 947,11x + 4295,4$	86,2 %	5,34 %	11304,01
$y = 4887,4x^{0,3939}$	87,1 %	7,39 %	10751,48
$y = 3168,5\ln(x) + 4357,3$	79,6 %	10,22 %	10698,99
$y = 4910,3e^{0,115x}$	90,0	4,84	11499,86

Source: calculated by the authors

productivity is projected to grow by 10 % compared to 2022. This growth is possible due to the improvement of technological processes, innovative solutions to production and prioritization of the most efficient labor methods.

Conclusions

Thus, the analysis of the dynamics of macroeconomic indicators of labor force utilization in Ukraine for the period from 2012 to 2022 led to the conclusion that in 2014, 2020 and 2022 there were negative trends in the country's economic development. Since 2021, there has been a gradual economic recovery, with GDP growing by 28.4 % compared to 2020, which is 13.6 % more than in 2012.

Labor productivity was chosen as an indicator of the efficiency of labor resources use. The constructed trend models of labor productivity dynamics (linear, power, logarithmic, and exponential) allowed us to determine the

forecast of this indicator for 2023, and the absolute error of the forecast was determined to be of high quality.

Hence, the prospect of further research is to determine the impact of changes in labor turnover on labor productivity. In order to draw economically reasonable conclusions about the efficiency of labor resources utilization in Ukraine, it is necessary to compare labor productivity with the same indicator of economically developed countries. Therefore, the next task of our study will be to assess and analyze the efficiency of labor resources in Germany as a country with a high level of economic development. This will allow us to determine the prospects for increasing the level of competitiveness and productivity of Ukraine's labor potential. This will allow us to identify the key factors that contribute to its successful use of labor potential and to take these aspects into account in the context of our further recommendations for Ukraine.

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