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TIME TREND MODELS IN THE STUDY OF DYNAMICS AND FORECASTING THE FIXED ASSETS COST IN UKRAINE

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Summary. *Dynamics of the fixed assets cost in Ukraine as one of the important factors influencing the volume of production and sales of products (goods, works, services) is investigated in this paper. The objective of the investigation is to model and forecast the fixed assets cost in Ukraine using time trend models. The interpretation of fixed assets in accordance with the National Accounting Regulations (Standards) is presented. The scientific achievements of scientists in the areas of studying the economic content, classification, recognition and assessment of fixed assets as well as the efficiency of their use, etc. are identified. According to the State Statistics Service of Ukraine, analysis of the dynamics of fixed assets in Ukraine for the period 2013–2024 was carried out. It was determined that during the investigated period, the fixed assets cost generally showed positive growth dynamics, with the exception of the decrease in 2015, 2017 and 2019. In general, during the investigated period, the fixed assets cost in Ukraine increased by 2,089,108 million UAH or by 20.1%. In order to construct the time trend model, the indicators of 2013–2014 were excluded from consideration on the basis that only since 2015 a certain trend has been built and relatively minor fluctuations in the studied indicator are observed. The time trend model of the dynamics of fixed assets in Ukraine for 2015–2024 was constructed in the form of a pairwise linear regression, its parameters were determined, and the constructed model was tested for adequacy with statistical data using the Fisher criterion. Analysis of the model was carried out: the coefficient of determination was used to determine the proportion of variation in the indicator explained by variation in the time factor; the correlation coefficient was used to establish the direction and strength of the relationship; the correlation index was used to assess the adequacy of the model; and the elasticity coefficient was used to determine the degree of elasticity of the fixed assets cost over time. The proper quality of the constructed model is confirmed by minor deviations of the calculated indicator values from the statistical ones (on average 3.52%). The forecast of the fixed assets cost in Ukraine for 2025 was carried out on the basis of the constructed time trend model, the forecast value of the indicator and its confidence interval were calculated with reliability of 0.95.*

Key words: *dynamics, modeling, fixed assets, forecasting, time trend.*

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ЧАСОВІ ТРЕНДОВІ МОДЕЛІ В ДОСЛІДЖЕННІ ДИНАМІКИ ТА ПРОГНОЗУВАННІ ВАРТОСТІ ОСНОВНИХ ЗАСОБІВ В УКРАЇНІ

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Резюме. *Досліджено динаміку вартості основних засобів в Україні як одного з важливих факторів впливу на обсяги виробництва та реалізації продукції (товарів, робіт, послуг). Метою дослідження є моделювання та прогнозування вартості основних засобів в Україні з використанням часових трендових моделей. Наведено трактування основних засобів відповідно до Національних положень (стандартів) бухгалтерського обліку. Визначено науковий доробок вчених у питаннях дослідження економічного змісту, класифікації, визнання та оцінювання основних засобів, ефективності їх використання тощо. За даними Державної служби статистики України проаналізовано динаміку основних засобів в Україні за 2013–2024 роки. Встановлено, що за період дослідження вартість основних засобів загалом мала позитивну динаміку до зростання, за винятком зменшення у 2015, 2017 і 2019 роках. Загалом протягом періоду дослідження вартість основних засобів в Україні зросла на 2089108 млн грн*

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або на 20,1%. Для побудови часової трендової моделі було виключено із розгляду показники 2013–2014 років на підставі того, що лише з 2015 року вибудовується певна тенденція і спостерігаються незначні коливання досліджуваного показника. Побудовано часову трендову модель динаміки основних засобів в Україні за 2015–2024 роки у формі парної лінійної регресії, визначено її параметри та проведено перевірку побудованої моделі на адекватність статистичним даним за критерієм Фішера. Проведено аналіз моделі: за коефіцієнтом детермінації визначено міру варіації показника, яка пояснюється варіацією фактора часу; за коефіцієнтом кореляції встановлено напрям і тісноту зв'язку; за індексом кореляції встановлено належну якість моделі; за коефіцієнтом еластичності встановлено міру еластичності вартості основних засобів за часом. Про належну якість побудованої моделі свідчать незначні відхилення розрахункових значень показника від статистичних (в середньому 3,52%). Виконано прогнозування вартості основних засобів в Україні на 2025 рік на основі побудованої часової трендової моделі, розраховано прогнозне значення показника та його довірчий інтервал з надійністю 0,95.

Ключові слова: *динаміка, моделювання, основні засоби, прогнозування, часовий тренд.*

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Statement of the problem. As stated in the National Accounting Regulation (Standard) 7 «Fixed Assets», «Fixed assets are tangible assets that the enterprise holds for the purpose of using them in the process of production or supply of goods, performance of work and provision of services, leasing to other persons or for the performance of administrative and socio-cultural functions, the expected useful life (operating period) of more than one year (or operating cycle, if it exceeds one year)» [1].

Thus, fixed assets that are included in the balance sheet of business entities and are used in the production of goods, performance of works, or provision of services ensure the possibility of carrying out economic activity. This determines their necessity and role in economic processes. The fixed assets cost is an important factor that affects the volume of production and sales of products (goods, works, services). Therefore, the investigations aimed at identifying trends and forecasting the fixed assets cost is relevant for all economic entities.

Analysis of available researches and publications. Issues of the economic content, recognition and valuation, depreciation, accounting, and analysis of fixed assets are revealed in papers by Honcharenko A. I. and Melnyk T. H. [2], Kopchykova I. V. and Kudyrko O. M. [3], Minkovska A. V., Shapovalova Ye. V., and Ionova K. O. [4], Myskin Yu. I., Myskina O. O., and Ilienko B. A. [5], Safonik N. P. and Vatashchuk V. V. [6], Shyshkovskyi S. V. and Yavorskyi R. T. [7], and others. In particular, Honcharenko A.I. and Melnyk T.H. state the purpose of their research in the following way: «identification, systematization and generalization of theoretical, methodological and practical aspects of recognition and valuation of fixed assets of the enterprise according to national and international standards» [2].

Minkovska A. V., Shapovalova Ye. V., and Ionova K. O. investigate the specific features of accounting for fixed assets while considering both financial and tax aspects. The authors propose to harmonize financial and tax accounting, namely, «to determine the value of fixed assets in NP(S)BO 7 at the tax level – exceeding 20,000 UAH and to establish minimum useful lives at the tax level» [4]. In the research by Kopchykova I. V. and Kudyrko O. M., «key aspects affecting the accounting of fixed assets under martial law are investigated: write-off of destroyed assets, depreciation calculation, inventory procedures, and formation of reserves for loss coverage» [3]. Scientists Myskin Y. I., Myskina O. O. and Ilienko B. A. consider depreciation and wear of fixed assets «as objects of accounting and analytical support for the enterprise management» [5], taking into account the importance of «correct and timely reflection of such assets in the financial statements of the enterprise» [5]. Scientists also investigate fixed assets of various sectors of the economy. For example, Shyshkovskyi S. V. and Yavorskyi R. T. [7] analyze the pre-war state of Ukrainian industry and use the fixed assets cost (capital) as one of the main indicators on the basis of which it is possible to forecast

economic recovery. The authors interpret the increase in the fixed assets cost under rather unfavorable conditions of the pandemic and full-scale war as the increase of industrial potential. At the same time, they prove the need to update fixed assets, which, in the context of scientific and technological progress and the application of advanced technologies, will result in the efficient replacement of another resource (labor) and, consequently, the possibility of reducing the number of employees under the conditions of labor resource shortage.

In turn, Safonik N. P. and Vatashchuk V. V. analyze the features of «increasing the efficiency of reproduction and use of fixed assets in the transport industry» [6]. At the same time, the scholars identify the key characteristics of fixed assets, research and expand their classification, determine the factors influencing the efficiency of reproduction and use of fixed assets, and develop a strategy for their management. In order to study economic indicators over time, the scientists use time trend models. In particular, scientists Dobuliak L. P. and Kostenko S. B., based on statistical data on the number of small enterprises, construct time trends of various analytical forms, on the basis of which they carry out an «quantitative assessment of small business development trends» [8] and make forecasts. Semenova V. H. and Semenova K. D. investigate «the main statistical forecasting methods based on data from a single time series» [9], and also consider «the peculiarities of using trend models for forecasting» [9].

Thus, scientists have significant experience in the investigation of economic content, classification, recognition and evaluation of fixed assets, the efficiency of their use, etc. However, we consider it reasonable to use time trend modeling in the investigation of the dynamics of the fixed assets cost in Ukraine for forecasting purposes.

Objective of the investigation is to carry out modeling and forecasting of the fixed assets cost in Ukraine using time trend models.

Statement of the task. In order to achieve the stated objective, the following scientific tasks have been defined: to reveal the essence of fixed assets and their role in economic activity; to investigate and assess the dynamics of the fixed assets cost in Ukraine; to construct the model of the time trend of the fixed assets cost and analyze the model; to forecast the indicator based on the constructed trend model. To solve the stated problem, the following methods were used: analysis, synthesis, generalization, analogy, systemic approach, modeling, tabular ones.

Presentation of the main research material. Based on data from the State Statistics Service of Ukraine, we will analyze the dynamics of the fixed assets cost in Ukraine for 2013–2024 (Table 1).

Table 1. Analysis of the dynamics of the fixed assets cost in Ukraine in 2013–2024

Year	*Fixed assets cost, million UAH.*	*In % to previous year*
2013	10,401,324	x
2014	13,752,117	132.2
2015	7,641,357	55.6
2016	8,177,408	107.0
2017	7,733,905	94.6
2018	9,610,000	124.3
2019	9,574,186	99.6
2020	10,577,278	110.5
2021	11,041,318	104.4
2022	10,654,555	96.5
2023	11,602,929	108.9
2024	12,490,432	107.6
2024 to 2013, abs.	2,089,108	x
2024 to 2013, %	20.1	x

*Calculated based on data from [10].

According to Table 1, during the investigated period, the fixed assets cost generally showed a positive growth trend, except the decrease in 2015 (by UAH 6,110,760 million or 44.4%), 2017 (by UAH 443,503 million or 5.4%), and 2019 (by UAH 35,814 million or 0.4%). This trend can also be observed in Figure 1.

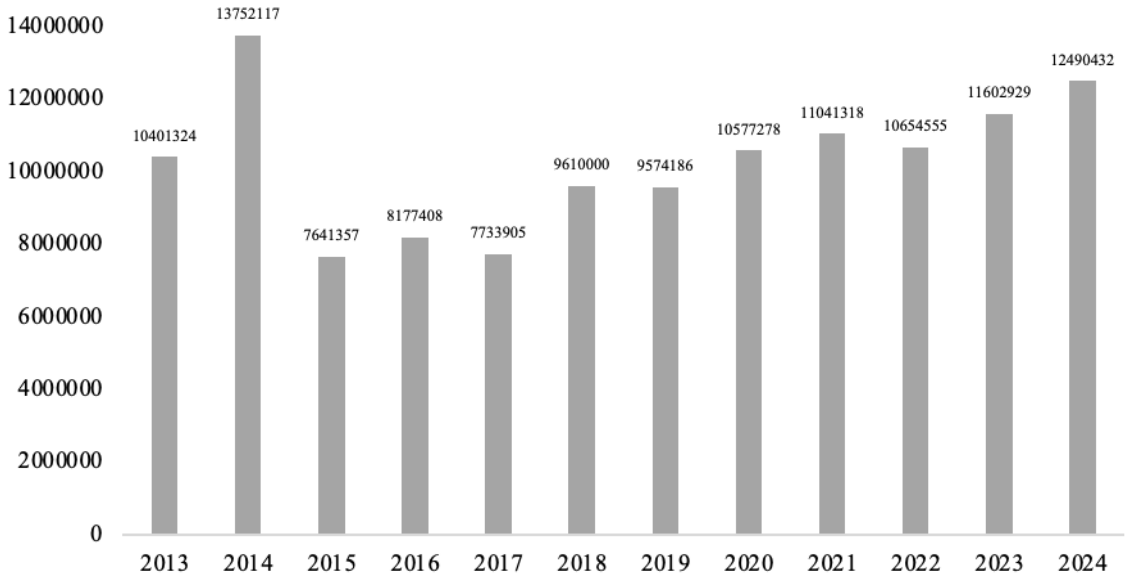

Figure 1. Dynamics of the fixed assets cost in Ukraine in 2013–2024, million UAH

*Constructed based on data from [10].

In general, if we compare the indicators of 2024 and 2013, the fixed assets cost in Ukraine increased by UAH 2,089,108 million UAH, which amounts to 20.1%.

To construct a time trend model, we will exclude the indicators of 2013–2014 from consideration, since a clear trend begins to form only from 2015 and minor fluctuations in the studied indicator are observed. The constructed time trend is shown in Fig. 2.

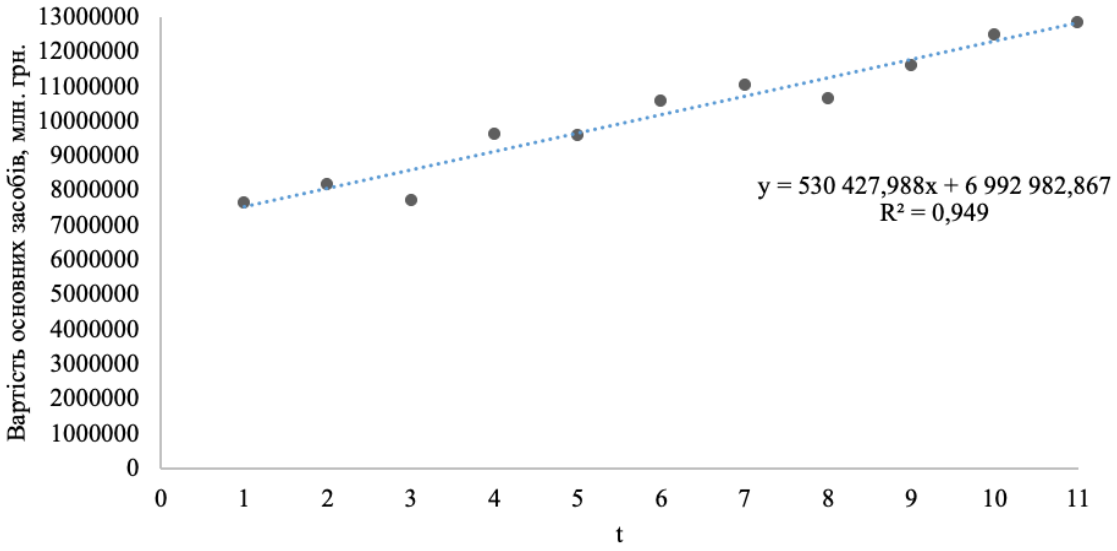

Figure 2. Correlation field and time trend line of the fixed assets cost in Ukraine for 2013–2024 and forecast for 2025 (t=11)

*Constructed by the author based on his own calculations using data [10].

The results of the investigation of the time trend model of the fixed assets cost in Ukraine, constructed in the form of paired linear regression, are presented in Table 2.

Table 2. Results of the investigation of the time trend model of the fixed assets cost in Ukraine in 2015–2024

Year	*Year number (t)*	*Indicator value (fixed assets cost), million UAH*		*Deviation of calculated data from statistical data*	
		Statistical data	*Calculated data*	*Abs., million UAH*	*Rel., %*
2015	1	7,641,357	7,523,411	-117,946	-1.54
2016	2	8,177,408	8,053,839	-123,569	-1.51
2017	3	7,733,905	8,584,267	850,362	11.00
2018	4	9,610,000	9,114,695	-495,305	-5.15
2019	5	9,574,186	9,645,123	70,937	0.74
2020	6	10,577,278	10,175,551	-401,727	-3.80
2021	7	11,041,318	10,705,979	-335,339	-3.04
2022	8	10,654,555	11,236,407	581,852	5.46
2023	9	11,602,929	11,766,835	163,906	1.41
2024	10	12,490,432	12,297,263	-193,169	-1.55
Sum	55	99,103,368	99,103,368	x	x

*Calculated by the author based on data from [10].

According to the Fisher criterion, the time trend model which we have obtained is adequate to the statistical data, since the calculated value of the criterion (110.58) exceeds its tabular value (5.32). Conclusions about the proper quality of the model can also be drawn on the basis of minor deviations of the calculated indicator values from the statistical ones (Table 2).

In general, we can state that for the constructed time trend model, the variation of the time factor explains 94.9% of the variation in the fixed assets cost in Ukraine.

The value of the correlation coefficient (0.966) indicates that the relationship between the time factor and the fixed assets cost is direct and strong.

The proper quality of the constructed model is evidenced by the fact that the correlation index is very close to 1 (0.966), and the points of the correlation field are located quite close to the trend line (Fig. 2).

According to the value of the elasticity coefficient calculated for the average values of the time factor and the indicator (0.29), it was found that with the increase in the time factor by 1%, the indicator, namely the cost of fixed assets, increases by 0.29%. The forecasted value of the indicator (the fixed assets cost in Ukraine in 2025, t=11) is shown in Fig. 2. According to our calculations, it amounts to 12,827,691 million UAH.

Considering that our calculations are of probabilistic nature, we also determined the deviation of the forecasted value of the indicator (1,222,179 million UAH) and its confidence interval [11,268,253; 13,712,611] million UAH with 0.95 probability.

Conclusions. So, we have considered the dynamics of the fixed assets cost in Ukraine in 2013-2024. General positive trend towards the increase in the fixed assets cost was observed, with the exception of 2015, 2017 and 2019. The time interval for modeling (2015–2024) was determined based on the absence of significant fluctuations in the indicator. The time trend model in the form of pair wise linear regression was constructed and analyzed. In particular, the coefficient of determination was used to determine the proportion of variation of the indicator, explained by the variation of the time factor; the direction and strength of the relationship were established by the correlation coefficient; the proper quality of the model was established by the correlation index; the elasticity coefficient determined the measure of elasticity of the fixed assets cost over time. Forecasting based on the obtained model, in particular, with 0.95 probability was carried out, the forecasted value of the indicator and its confidence interval were determined.

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