Accounting and analytical space of providing the depreciation policy of Ukrainian enterprises

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Abstract

The article considers the accounting and analytical space to ensure the depreciation policy of Ukrainian enterprises. The paradigm of accounting and analytical support of depreciation policy is proposed, which allows to systematize rational ways of cost allocation or value of capital assets (minus liquidation value) throughout their life, taking into account accounting, information, analytical, control and innovation and investment component. It is proved that the components of accounting and analytical support of depreciation policy of Ukrainian enterprises in the institutional economy, determine the priorities of innovative renewal of assets based on accumulation and use of the depreciation fund. Methods of reporting and accounting support of depreciation policy are identified. A graphical model of the digressive method for determining depreciation deductions is presented. The growth rates of the value of fixed assets and the degree of their depreciation in Ukraine are analyzed. The functional dependences of costs for improvement (reconstruction, modernization) of fixed assets on the amount of accrued depreciation of enterprises of the Steppe zone of Ukraine are defined. The forecast volume and intervals of depreciation of fixed assets at enterprises are calculated.

Key words: capital investments, innovations, fixed assets, economic entities, rates.

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1. Introduction

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The most effective state policy of developed countries in terms of stimulating sustainable innovative development and investment in technological re-equipment of agriculture is a comprehensive construction of accounting and information space, which provides the formation of transparent programs to support depreciation policy to increase sustainable development of agricultural businesses. The key elements of the introduction of depreciation policy aimed at the timely formation of own investment resources through depreciation deductions are the accumulation of extended databases through exchange, analytical procedures and the formation of reporting information exclusively in electronic form. This ensures the efficiency, openness and effectiveness of management decisions. Unfortunately, in agriculture of Ukraine, enterprises have a significantly lower level of technological weapons, and therefore need accelerated innovation recovery (Balanovska et al., 2021; Dunayev et al., 2019; Lukhmanova et al., 2019; Markina et al., 2018; Jiang et al., 2019). Ineffectiveness of the concept of depreciation policy in the state, which did not lead to significant changes in the basic provisions of the accounting space and regulatory institutions, encourages the search for new rules of its compliance with the requirements of innovation and investment development, highlighting the role of accounting in realization of depreciation policy, as well as the basics of methodology and organization of information support of depreciation policy (Kuzub et al., 2022; Harust et al., 2022; Mishchenko et al., 2021; Nesterova et al., 2018; Verkhoglyadova et al., 2022; Shalbolova et al., 2017).

Depreciation policy as an integral part of the economic policy of the state is a specific lever, which is aimed at business activities of separately functioning economic entities. Its main purpose is to create conditions for the reproduction and renewal of fixed assets, intensification of investment processes to accelerate innovation (Lagovska et al., 2020; Kholod et al., 2021). Depreciation policy can be focused on the objects of amortization (intangible assets, fixed assets, labor, funds, etc.), as well as on individual processes and indicators – pricing, taxation, wages, fixed costs, etc. That is, depreciation policy is a long-term management of the reproduction process of all major resources used in the enterprise for a long time, and the impact on related economic processes and indicators to improve the financial and economic condition of the enterprise (Pedchenko and Luhivska, 2014; Shpak et al., 2018; Deineha et al., 2021; Korzhyk et al., 2021; Ivanov et al., 2019). Depreciation policy should be aimed at increasing the financial interest of enterprises in investing in fixed assets at the expense of the depreciation fund (Halushko, 2011; Dubodelova and Kulyniak, 2016). At the same time, it is necessary to pay attention to the

accounting role of depreciation in the issue of objective reflection of income and expenses of enterprises and determining its real financial result in accordance with the principles of accounting. One of the effective, but not fully implemented measures is to provide tax rebates only to those businesses that have documentary evidence of investment use of the depreciation fund. The priority is to define the multifaceted characteristics of depreciation as an element of the method of accounting, which reduces the potential of material services for revaluation of assets in order to increase the contribution to net income and maintain production capacity (Dunayev et al., 2021; Pavlova et al., 2021; Akhmetov et al., 2022; Mishchenko et al., 2018; Paliienko et al., 2020).

Such scientists as K. Petkova and A.J. Weichenrieder (2020), D. Jorgenson (1996; 1974), B. Fraumeni (1997), D. Trachova (2016), C. Wang (2021) studied the theoretical and practical aspects of the formation of depreciation policy at the state level. From the standpoint of institutional accounting theory, information society theory and information security issues, non-current assets were investigated by E. Surriley (1971), C. Messere and J. Gilroy (1971), M. Bondar and V. Babich (2016), N. Levchenko and I. Vorobiova (2014), O. Lyshchenko and V. Pivnenko (2015), N. Shvets (2016), M. Chumachenko (2004), P. Khomyn and I. Pyrih (2007), A. Syisoyev (2006), W.C.Y. Li and B.H. Hall (2020).

The purpose of this study is to develop a paradigm of accounting and analytical support of depreciation policy of enterprises in an institutional economy, which allows determining the priorities of sustainable innovative renewal of assets based on accumulation and use of the depreciation fund.

2. Materials and Methods

Depreciation as an economic phenomenon affects economic indicators and directly the choice of depreciation policy of enterprises, which requires a comprehensive study in the context of coordination of strategic decisions of innovation and investment development for the achieving of the well-being of society. This policy can be developed both at the macro level (state) and at the micro level (individual enterprise) (Borysenko, 1993; Dunayev et al., 2020). Thus, at the macro level these are generalizing strategic decisions based on theoretical and methodological provisions, the end result of which is the creation of an appropriate legal framework and at the micro level – these are specific strategic

decisions made at a particular enterprise, according to the situation of the external and internal environment (Figure 1).

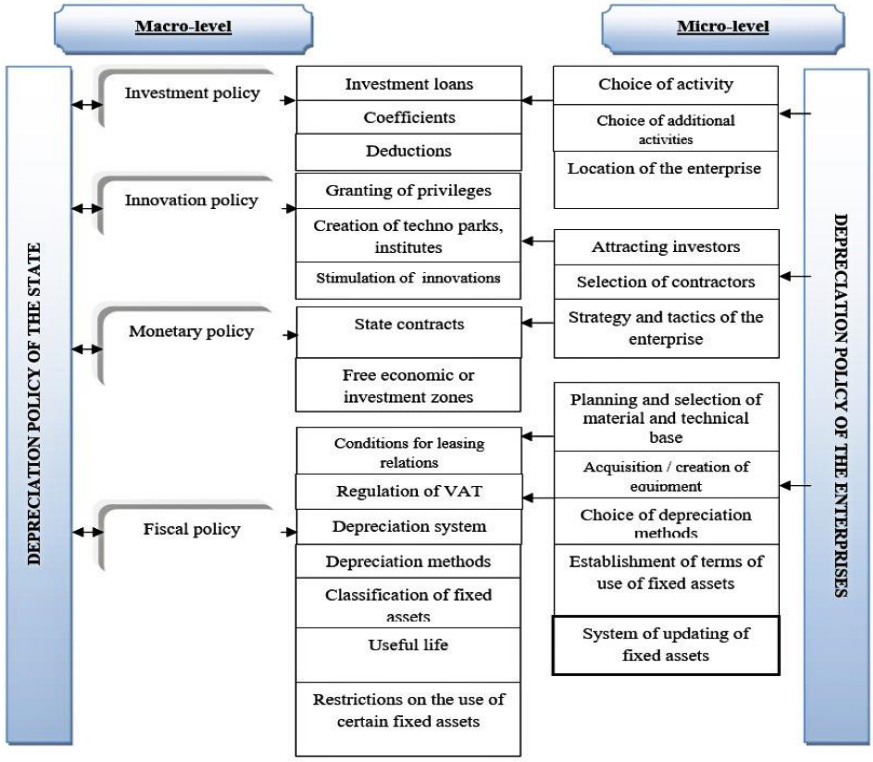

Figure 1. The relationship of depreciation policy at the macro and micro levels

In the context of this area, the authors proposed a paradigm of accounting and analytical support of depreciation policy, which allows to systematize rational ways of allocating costs or value of capital assets (minus liquidation value) throughout their life, taking into account information, accounting, analytical, control and innovative-investment component. (Figure 2). The paradigm is implemented on the basis of the methodology of accounting for innovation-oriented depreciation policy, preparation of the information environment of accounting data of depreciation policy, the formation and use of reporting information for the management of depreciation policy, as well as methods of accounting for the formation of the depreciation fund, depreciation, preparation of reporting documentation, statistical observation, evaluation of efficiency and monitoring of the application of the information system of depreciation policy.

Indicators of the performance of the paradigm were developed on the basis of data from countries that were selected to implement the method of depreciation and based on

the positive dynamics of such countries, including Japan and Canada (in terms of depreciation and capital investment). The level of innovative-investment activity is proposed according to the indicators of the EU innovation scoreboard in accordance with the level of EU countries with similar sustainable development prospects, in particular Poland, Hungary and Slovenia (Pawlik and Shaposhnykov, 2018; Bobkova et al., 2020).

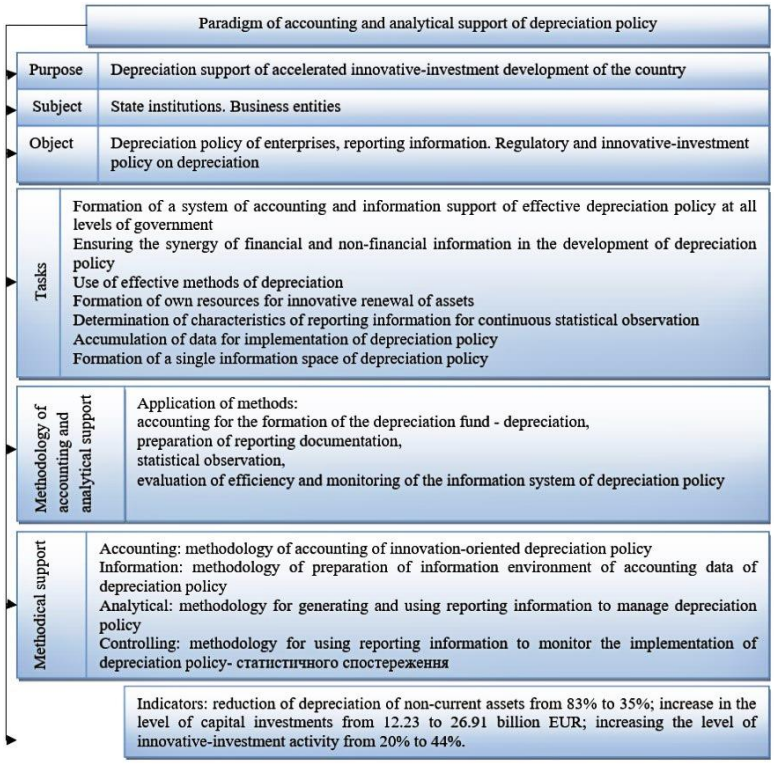

Figure 2. The paradigm of accounting and analytical support of depreciation policy

Determining the characteristics of reporting information for continuous statistical observation will allow accumulating an array of data for the effective implementation of depreciation policy by forming a single information space (Figure 3).

The paradigm is aimed at fulfilling the strategic objectives of depreciation policy, namely the formation of a system of accounting and information support of effective depreciation policy at all levels of government by ensuring the synergy of financial and non-financial information in developing depreciation policy, for which the most effective methods of depreciation for sustainable economic development are used, which will allow to form sufficient own resources for innovative renewal of assets. It should be noted that the depreciation process affects only the profitability of enterprises, so it can be used to reduce the tax burden, and this can best be implemented using accelerated methods of

depreciation (accelerated write-off of fixed assets). The use of the accelerated depreciation mechanism is advisable for financially stable organizations, whose unit costs are significantly lower than those of competitors, which offsets the increase in costs and the decrease in the size of the financial result reflected in financial statements. At the same time, when studying the depreciation process it is necessary to pay attention to the following elements: accelerated write-off of fixed assets; reduction of profits and, accordingly, tax pressure; increase in the amounts of accrued depreciation deductions. These elements are important factors for the study of depreciation policy, which is formed at a particular enterprise, taking into account external factors (general economic situation, inflation, supply and demand, etc.).

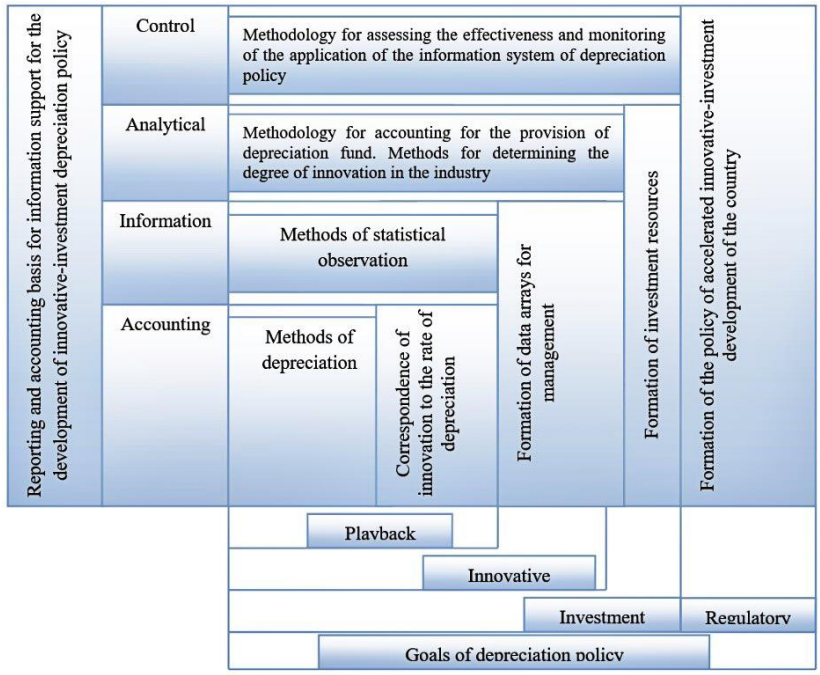

Figure 3. Reporting and accounting support for depreciation policy

Therefore, without a comprehensive analysis it is impossible to obtain a generalized picture of the state of development of the depreciation process in the economy. To improve the methods of analyzing the depreciation process of enterprises, the authors propose the indicator "depreciation capacity" (D_c), which will be determined by formula (1) (Lyshchenko and Pivnenko, 2015):

$$D_c = \frac{D_d}{Fa_0}, \quad (1)$$

where: D_d – the amount of depreciation, which is given in the report on the financial results of the enterprise (as part of annual operating expenses), EUR; Fa_0 – initial cost of fixed assets, EUR. The economic essence of this indicator is that it establishes the amount of depreciation (in UAH or kopecks) per currency unit of fixed assets. The availability of alternative methods of depreciation, allowed by the state, gives companies the right to choose the available alternatives to consolidate the depreciation policy (Sadovska and Vozdihan, 2014; Kachynska et al., 2022). However, the change in the methodological approach to depreciation in the modern economy does not increase depreciation as a source of investment of economic entities and the motivation to renew fixed assets. In this aspect, special attention is paid to the study of the state and efficiency of use of fixed assets. After all, fixed assets are a necessary factor of any production, the efficiency of their use is directly proportional to the final results of economic activity of enterprises and creates an opportunity to increase production without additional capital investment (Shvets, 2016; Dinzhos et al., 2020). It is believed that the application of the digressive method of calculating depreciation deductions will create a model of enterprise operation, in which the amount of profit will depend only on objective factors, i.e., the volume of manufactured and sold products. This is most important for large business entities, as it creates objective conditions for the formation of dividend policy, which will not depend on the cyclical fluctuations of the reproduction of fixed assets and the corresponding fluctuations in the amount of profit.

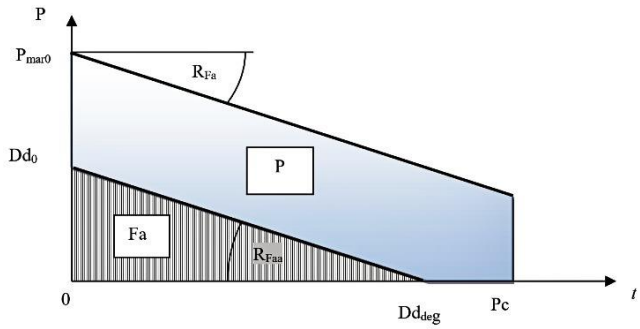

Figure 4. Graphic model of the digressive method of determination of depreciation deductions

Note: $Pmae_0$ and Dd_0 – the initial (marginal) value of marginal profit and depreciation; Pc and Dd_{deg} – the estimated depreciation period and the depreciation period by the additive method of calculation; R_a – depreciation profitability.

The model for calculating depreciation by the digressive method is presented in Figure 4, which shows that the marginal profit $Pmar_0$ (the sum of depreciation deductions (D_d) and profit (P)) varies from the initial value of profit P_0 evenly and in proportion to the terms of operation. If depreciation deductions are calculated according to this scheme, the amount of profit for an inertial economic system in which output is constant will be a constant value. The basic indicators of this method can be determined by formulas (2-3) (Lyshchenko and Pivnenko, 2015):

– initial (marginal) value of depreciation deductions:

$$Dd_0 = \sqrt{\frac{2 \cdot Fa_0 \cdot Pmar_0}{P_c}}, \quad (2)$$

– depreciation period for this digressive method:

$$Dd \sqrt{\frac{2 \cdot Fa_0 \cdot P_c}{P_{mar_0}}}_{deg}, \quad (3)$$

where: Fa_0 – the initial cost of fixed assets; $Pmar_0$ – the annual value of the marginal (initial) profit; P_c – estimated period of operation. The use of such a method of calculating depreciation allows eliminatingthe effect of secondary factors on the amount of annual profit for the inertial economic system. That is, when production and sales are a constant value, profit will also be a constant value almost until the end of the settlement period. This is the only technique that allows getting this result. Special methods of depreciation policy should be used during the development of crisis phenomena, i.e., a special system of crisis management should be formed to reduce the pressure on the activities of enterprises by external factors: a significant decline in demand for manufactured products; decrease in the price level (as a consequence of the decline in demand); possible development of inflation and other negative processes (Bondarb and Babich, 2016). Accordingly, it only makes sense to use two methods of calculating depreciation (uniform and slow), when there is a recession and the country's economy begins to develop with an annual increase in agricultural output. The application of accelerated depreciation in such a period is theoretically possible, but for practical reasons is a gross error, as it will significantly worsen the financial condition of enterprises in the long run.

3. Results

Currently, the process of depreciation is declarative in nature, and its quality component depends on the size and taxation system of agricultural enterprises of Ukraine. Amounts of accrued depreciation are not considered by accountants within the direct purpose as a source of investment in the renewal of fixed assets. In modern economic realities, the amount of accrued depreciation is used as a tax lever to influence the taxable profit of the enterprise. Thus, when calculating the depreciation of the enterprise of Ukraine, the norms of the Tax Code are observed according to the recommended terms of using fixed assets. However, many violations have been identified in terms of the purpose of depreciation methods. That is, in the case of long-term operation of a non-current asset, it is impossible to change only the method of depreciation, it is necessary to simultaneously revalue such assets. Revaluation of assets entails the occurrence of income from the revaluation and, accordingly, tax liabilities. Thus, the comparative analysis of the sums on which depreciation receipts and the sums of tax liabilities increase testifies to economic inexpediency of such actions. In the dynamics of gross accumulation and consumption of fixed capital and related economic processes, there is a certain discrepancy between the depreciation processes. Thus, the amount of depreciation deductions increases annually, but there is a clear increase in the share of depreciation of non-current assets, and the growth rate of these indicators is not the same.

Based on the data of the state statistical observation, time series were constructed and the growth rates of the value of fixed assets and the degree of their depreciation were determined (Official site of the State Statistics Committee, 2019; Osaulenko et al., 2019; Review of international experience, 2018) (Figure 5).

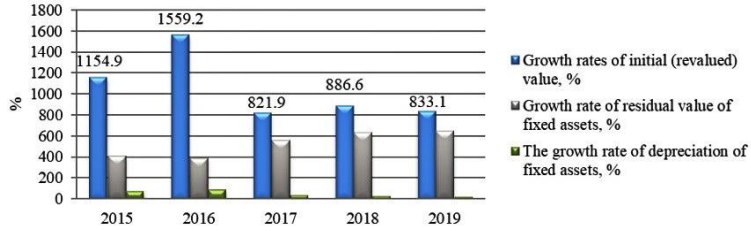

Figure 5. Growth rates of fixed assets and the degree of their depreciation in Ukraine for 2013-2019, %

Thus, the lack of control over compliance with even the existing norms and methods of depreciation worsens the already slow process of renewal of non-current assets of Ukrainian enterprises. This situation is exacerbated by the lack of control by the state, as in the standard forms of annual financial statements there are only informative indicators

of the value of non-current assets, the amount of accumulated depreciation and the use of these funds. The dynamics of indicators of value and depreciation of fixed assets confirms that they are due to the revaluation of fixed assets and inflation, which affect the cost of renewal of assets. At the same time, the share of depreciation costs increases every year due to the accelerated disposal of old assets and their replacement with new ones with a higher value and, accordingly, a larger amount of depreciation deductions. However, the sources of such replacement need further research, as in the last five years (2015-2019) there has been an increase in the level of enterprise losses on average in the country.

Objective integrated processes of physical and moral depreciation of fixed assets determine the existence of two directions in the investment process: the renewal of the existing fleet of machinery and equipment and the introduction of innovative technologies. The defining feature of an effective depreciation policy is the dynamics of inflow and accumulation of depreciation resources, which allows to provide a sufficient number of resources, both for complete simple reproduction of capital elements and for creating a "core of start-up capital" to ensure modernization of production. At the same time, the coordination of structuring and detailing of investment flows should be defined as the reproducible balance of fixed capital according to the formed sources of financing (Consequences of the change..., 2017; Official site of the State Statistics Committee, 2019; Osaulenko et al., 2019; Review of international experience, 2018) (Table 1).

Table 1. Dynamics of capital investments in fixed capital of enterprises by sources of financing in Ukraine

Year	Mastered (used) capital investments at the expense:							
	of the state budget		of the local budgets		of the own funds of enterprises and organizations		including depreciation	
	million EUR	% of total	million EUR	% of total	Million, EUR	% of total	Million, EUR	% of total
2015	184.9	2.5	208.5	2.8	4655.5	63.4	564.8	12.1
2016	81.1	1.2	175.4	2.7	4581.6	70.5	765.9	16.7
2017	18.4	2.5	422.5	5.2	5462.3	67.5	1007.1	18.4
2018	274.5	2.6	794.6	7.5	7370.9	69.3	1068.3	14.5
2019	208.3	2.0	688.2	6.7	7449.8	72.7	1055.4	14.2

Thus, according to Table 1, in the structure of sources of investment financing, the mechanism of accumulation of funds for asset renewal depends almost entirely on the organization of accounting and accounting policy of Ukrainian enterprises. The low share of depreciation deductions confirms the need to develop a regulatory and organizational

part of the depreciation policy in order to perform the main function of depreciation deductions – investment financing. This is due to the difficult availability and high cost of credit resources and low awareness of various programs to support and develop certain sectors of the economy and industries. Thus, the depreciation policy of the enterprise should become an element of general strategic management, which includes the accepted method of depreciation in coordination with the tax procedure, which allows ensuring the reproducible balance of fixed capitalin the planned period. Thus, on average, enterprises in the regions of Ukraine spend the depreciation fund on capital investment within 32% of the total cost of renewal of non-current assets, with the overall growth rate of the capital investment index in the country as a whole (Official site of the State Statistics Committee, 2019; Osaulenko et al., 2019; Review of international experience, 2018).

The period of 2017-2019 for Ukrainian enterprises was the most critical in terms of the level of capital investment financing (the maximum value of capital investment growth was below 40%), (Consequences of the change..., 2017; Official site of the State Statistics Committee, 2019; Osaulenko et al., 2019; Review of international experience, 2018).

It is determined that the degree of depreciation of non-current assets is directly dependent on the size of the enterprise. For small enterprises of Ukraine in 2018-2019 it was from 23% to 48%, for large – 94% (Consequences of the change..., 2017; Official site of the State Statistics Committee, 2019; Osaulenko et al., 2019) (Figure 6).

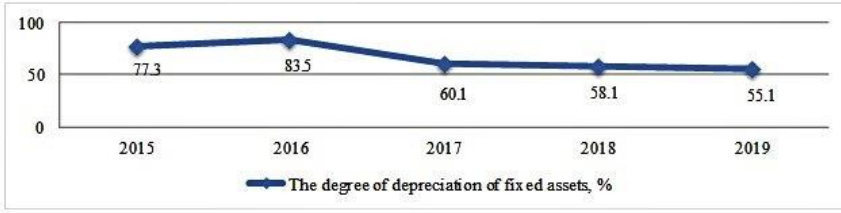

Figure 6. Dynamics of the degree of depreciation of fixed assets in Ukraine, %

Thus, Ukrainian enterprises need a radical reform of depreciation policy, as the current state of consideration of the accumulation of depreciation fund cannot serve as a real source of investment not only in innovative re-equipment of production facilities, but also for simple reproduction of fixed assets. Accordingly, in the country there is a predominance of funds of enterprises in the structure of funding sources (Consequences of the change..., 2017; Official site of the State Statistics Committee, 2019; Osaulenko et al., 2019) (Figure 7). Thus, the main areas of renewal of non-current assets are machinery

and equipment – 34.8% of the total investment, vehicles – 12.3% and engineering structures – 18.4%.

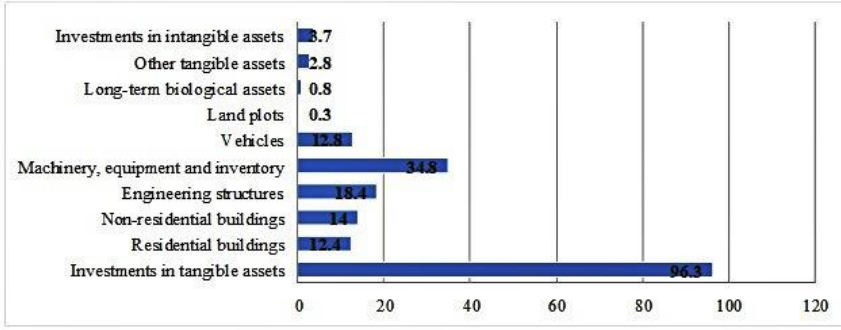

Figure 7. The structure of capital investment by the type of assets of enterprises of Ukraine in 2019, %

4. Discussion

Global trends in the development of depreciation systems are aimed at significantly liberalizing them, significantly reducing the number of depreciation rates, establishing them for large groups of fixed assets and giving companies the right to determine depreciation periods within the statutory limits (Ostorovetskyi, 2017). Thus, in the countries of the world, the share of funds as depreciation for the operation of the asset and the release of funds from taxation in the total amount of investment in innovation is from 60% to 85%. The stability of depreciation funds as a source of profit increases their resistance to fluctuations in production, interest payments for borrowed funds, changes in pricing policy, etc. (Shvets, 2016; Kvasnytskyi et al., 2020). In Ukraine, companies do not have the opportunity to withdraw funds from circulation for a period of 10-15 years in accordance with the average life of non-current assets. If we separate from this calculation computers and devices that have a short service life and a small share in the total value of non-current assets, we obtain an average figure of 15 years. By reducing the service life and determining significant amounts of depreciation, companies will be able to form a depreciation fund in one or two years, and then the state will be able to stimulate the use of savings to modernize production according to national standards of innovation development standards. In addition, it will stimulate enterprises to sustainable innovative development and targeted use of funds received. Therefore, the capital investment budget, which is an integral part of the main budget, provides for the forecasting of depreciation

deductions – the own financial resources of enterprises (Pylypenko and Demska, 2018; Harust et al., 2021). Let us prove it on the example of indicators of the enterprises of the Steppe zone of Ukraine. The first stage of forecasting the amount of capital investment was the construction of trend models. However, they had insignificant coefficients of determination (from 56.17% to 69.59%) and high values of relative and absolute errors. Therefore, the next step is to apply correlation-regression analysis. To establish the relationship between the indicators of sources of funding and the amount of capital investment (including capital repairs and improvements (reconstruction, modernization)), the coefficients of pair correlation were calculated.This made it possible to quantify the density (strength) of the linear relationship between the variables.The obtained values of correlation coefficients (0.821) revealed a strong direct relationship between the cost of improvement (reconstruction, modernization) and the amount of accrued depreciation of fixed assets. It should be noted that the share of expenses for improvement (reconstruction, modernization) in the total set of capital investments of the enterprise on the average makes 86%. To substantiate the actions aimed at achieving the goal – forecasting the amount of costs for improvement (reconstruction, modernization), the statistical dependence and impact on the performance indicator (Y) of the amount of accrued depreciation of fixed assets (X_1) was revealed. Data are taken for 36 quarters. As a result of calculations, the following model (4) is received (Voloshchuk, 2011):

$$Y = 10.71 + 0.081X_1, \quad (4)$$

The linear regression model of the two above indicators had an insufficiently high coefficient of determination (R^2=0.765). In order to qualitatively improve the model of dependence of costs for improvement (reconstruction, modernization) on the amount of accrued depreciation of fixed assets, parabolic, hyperbolic, logarithmic, power and exponential functions are additionally calculated (Table 2).

Table 2. Functions of dependence of costs for improvement (reconstruction, modernization) of fixed assets on the amount of accrued depreciation of enterprises of the Steppe zone of Ukraine

Function type	Determination factor (R^2)	Fisher's criterion (F)	Relative model error (E)	Absolute model error (Δ)
Linear	0.765	108.449	110.913	22.313
Parabolic	0.765	110.078	53.829	22.648
Hyperbolic	0.437	167.932	26.436	34.552
Logarithmic	0.672	128.233	69.648	26.384

Power	0.822	0.244	157.106	0.050
Exponential	0.793	0.263	130.216	0.054

Given the indicators of Table 2, the power function (5) is chosen optimal for the analysis (5) (Voloshchuk, 2011):

$$Y = 0.119X^{0.951}. \quad (5)$$

Thus, the planning of the cost of improvement (reconstruction, modernization) requires a forecast of depreciation with high accuracy and reliability. To do this, trend models are constructed that describe the amount of depreciation of fixed assets (Figure 8). In order to illustrate the calculations presented in Figure 8, the linear, logarithmic and polynomial trends of the actual indicators of depreciation deductionsare shown, the calculations of which are given in Table 3.

Table 3. Equation of trend lines of the amount of accrued depreciation of fixed assets of enterprises of the Steppe zone of Ukraine

Trend	Model	Coefficient of determination
Linear trend	$Y=2808.30+178.06X$	0.626
Logarithmic trend	$Y=479.99+2114.6ln(x)$	0.595
Power trend	$Y=1483.4x^{0,49}$	0.608
Exponential trend	$Y=2791.4e^{0,036x}$	0.494
Polynomial trend	$Y=1488.7+579.56x-26.79x^2+0.48x^3$	0.659

The accuracy of the model with a power trend, the initial coefficient of determination of which was 60.8% is 93.01%. For this model it was possible to eliminate the influence of cyclic fluctuations (Afanasev and Yuzbashev, 2010; Anderson, 1976). The situation with the linear trend is almost identical (92.92%), but the accuracy of the model with the polynomial trend is only 77.83%.

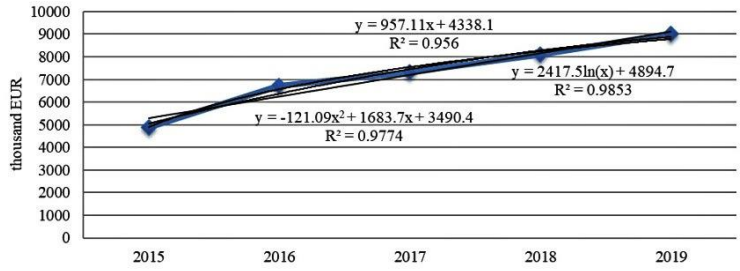

Figure 8. The actual amount of accrued depreciation by the trend lines of the enterprises of the Steppe zone of Ukraine, thousand EUR

Since, in Figure 8 systematic fluctuationsare traced, which differ significantly from each other, then in order to identify the size of the cycle (seasonality) and increase the reliability of the trend model, the additive model, which is presented in the form of formula (6) was used and the influence of cyclic factors m=4 was eliminated. The result was the data shown in Table 4. Therefore, the application of such an analysis of the algorithm allowed obtaining results with a high degree of reliability and with insignificant relative errors. In addition, this approach allows taking into account the cyclicity of the studied series, and it is advisable to calculate the parameters of this component by decomposing it into a Fourier series. The Fourier series is described by the following equation (formula (6)) (Afanasev and Yuzbashev, 2010; Anderson, 1976):

$$Y = a_0 + \sum_{n=1}^{\omega}(a_i \cos t\, x + b_i \sin t\, x), \quad (6)$$

in this case $t = 2\pi f_i$, where: a_0 – is a constant; a_i, b_i – amplitudes of the corresponding functions, regression coefficients; i – number of corresponding harmonics with the corresponding value of frequency; t – time, expressed in radians or degrees. The alignment according to the given formula is carried out in cases when in the empirical series there is a certain periodicity of changes in its levels, which acts as sinusoidal fluctuations, i.e., harmonics of fluctuations, and sinusoids obtained by Fourier series alignment are harmonics of corresponding orders. Periodic fluctuations in the dynamics of the amount of accrued depreciation are clearly traced for the investigated enterprise. When aligned by a Fourier series, the periodic fluctuations of the levels of the time series appear as the sum of several harmonics (n), layered on top of each other. For example, at n=1 the Fourier equation will look like (formula (7)) (Afanasev and Yuzbashev, 2010; Anderson, 1976):

$$Y = a_0 + a_i \cos t + b_i \sin t. \quad (7)$$

When n=2, respectively (formula (8)) (Afanasev and Yuzbashev, 2010; Anderson, 1976) (Afanasev and Yuzbashev, 2010; Anderson, 1976):

$$Y = a_0 + a_i \cos t + a_2 \sin t + a_3 \cos 2\,t + a_4 \sin 2\,t. \quad (8)$$

Depending on the value of time (t) we find the corresponding values of cos and sin. The parameters of the equation of theoretical levels are determined by the method of least squares. Finding the partial derivatives of the Fourier series and equating them to zero, we obtain a system of normal equations by which can be calculated the parameters (formula (9-11)) (Afanasev and Yuzbashev, 2010; Anderson, 1976):

$$a_0 = \frac{\sum y}{n}, \quad (9)$$

$$a_1 = \frac{2\sum y \cos t}{n}, \quad (10)$$

$$a_2 = \frac{2\sum y \sin t}{n}, \quad (11)$$

The calculations show a low coefficient of determination, the root mean square error exceeds the sum 2000, the approximation error after the alignment of the first harmonic was 49.59%. Thus, the optimal model for this approach could not be determined, although it is the most sought after and relevant. It can be assumed that the sample is insufficient and provided the construction of a series, for example, with monthly data we will be able to build a qualitative model of the trend of depreciation of fixed assets (Cottarelli, 2011). However, we used another approach – to select only a sinusoidal trend from the studied series of dynamics. Since the values of each harmonic are a series of values that are repeated with the correct periodicity in the form of a sinusoid with the corresponding frequency, *ai* can be described by the following formula (12) (Afanasev and Yuzbashev, 2010; Anderson, 1976):

$$a_i = b_i \, sin(\, 2\pi f_i \phi_i), \quad (12)$$

where: b_i – amplitude of fluctuations; f_i – frequency of the *i*-th harmonic; φ_i – phase fluctuation of the *i*-th harmonic. If φ_i – is a phase fluctuation, it can be described as the difference between the actual values of the indicator (*X*) and the values of the initial phase of fluctuations *(C),* then the equation of the sinusoidal trend with a period of fluctuations 4 (quarters of the initial series of values of depreciation of fixed assets of the studied enterprises of the Steppe zone of Ukraine) will have the following form (formula (13)) (Afanasev and Yuzbashev, 2010; Anderson, 1976):

$$Y = a + b \times sin\left(\frac{2\pi}{4}(x - c)\right), \quad (13)$$

where: *Y* – trend function; *a* – offset of the sinusoid relative to zero; *b* – amplitude of a sinusoid; *c* – the value of the initial phase of fluctuations; *x* – the actual value of the indicator. The sinusoidwas again aligned with four harmonics. The calculations of the forecast for the harmonics of the presented trend function showed the insignificance of the coefficients in the theoretical time series for the second and third harmonics and the correlation of the trend line with the forecast line was considered insignificant. The next step was to calculate the seasonal (cyclical) component and calculate the sum of trends

and the seasonal component. The Fourier series function for the enterprises of the Steppe zone of Ukraine has the form (formula (14)) (Afanasev and Yuzbashev, 2010; Anderson, 1976):

$$Y = 6102.33 - 1154.49\,sin\left(\frac{\pi}{2}(x - 3.17) + 100\,sin(\,2\pi(x - 0.5)\right). \qquad (14)$$

Calculations show that the root mean square error for the theoretical values of depreciation of fixed assets, calculated using Fourier series equations, is 465.96 and is less than the root mean square error for time series, aligned by other models. In addition, the approximation error determined for the trend model by Fourier series equations corresponds to the established limits. The coefficient of determination is 96.85%. The values of the coefficients are reliable, which confirms that the student's calculation criterion exceeds the tabular one more than 2.0 times. The calculated value of the Fisher criterion is several times higher than in the table. The graphical image (Figure 9) visually confirms that the points of the curve aligned by the Fourier series equation on the second harmonic are closest to the values of the actual time series. Based on the obtained Fourier series function for the enterprises of the Steppe zone of Ukraine, confidence intervals are determined for the amount of depreciation of fixed assets for the next 4 quarters (the accuracy of calculating the planned cost of improvement (reconstruction and modernization) is 93.01%.

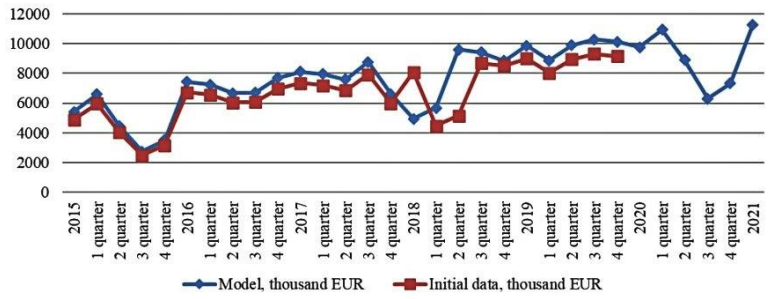

Figure 9. Forecast of depreciation of fixed assets of enterprises of the Steppe zone of Ukraine for 2020-2021, thousand EUR

The result is the following data, which are shown in Table 4.

Table 4. Confidence intervals for the forecast of depreciation deductions and costs for improvement (reconstruction, modernization) of fixed assets of the enterprises of the Steppe zone for 2020, thousand EUR

Quarter	Depreciation of fixed assets			Costs of improvement (reconstruction, modernization)		
	Lower limit of the confidence interval	Forecast data	Forecast data, Upper limit of the confidence interval	Lower limit of the confidence interval	Forecast data	Forecast data, Upper limit of the confidence interval
1 quarter. 2020	8050.93	8475.43	8899.93	616.60	647.48	678.29
2 quarter 2020	5690.87	5990.93	6290.99	443.32	465.53	487.67
3 quarter 2020	6631.85	6981.53	7331.21	512.77	538.45	564.06
4 quarter 2020	10206.47	10744.63	11282.79	772.66	811.35	849.95

Therefore, the proposed approach to the analysis of the efficiency of use of fixed assets takes into account the weaknesses in the development of a particular research enterprise and can be used to predict the optimal value of fixed assets. The methods used for the analysis allow to take into account the peculiarities of the use of fixed assets and to provide clear proposals for improving the efficiency of their operation at the enterprises of the Steppe zone of Ukraine. This takes into account the impact of fixed asset management on the performance of enterprises. Within one enterprise of the Steppe zone of Ukraine, a possible increase in the rate of depreciation is forecast, provided that the profit is 100% directed to the provision of the depreciation fund (Figure 10).

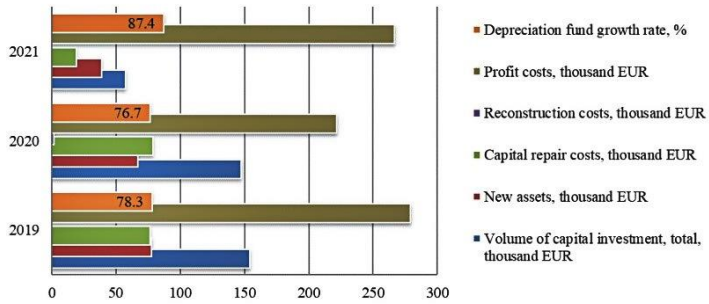

Figure 10. Forecast of growth of rates of depreciation on the average on one enterprise of the Steppe zone of Ukraine on the condition of a direction of profit on maintenance of depreciation fund for 2019-2021, thousand EUR

5. Conclusions

Thus, the accounting role of depreciation in the objective reflection of income and expenses of enterprises and determining its real financial result in accordance with the

principles of accounting is effective provided that measures are taken to provide tax rebates only to those entities that have documentary evidence of investment use of depreciation fund. Such an element of control in combination with significant measures of state protectionism will allow to obtain positive sustainable results. The need for such measures is associated with rapid inflation, in which the accumulation of funds in the accounts of enterprises is not possible and is risky, which affects the well-being of the enterprise. Accumulation of funds in foreign currency, which has smaller exchange rate of fluctuations in Ukraine, is also impossible (companies must make calculations and accumulate funds mainly in national currency with the establishment of the percentage of revenue credited in the currency). Therefore, the main stages of formation of accounting support for depreciation policy at enterprises should be: accounting for the main factors that determine the prerequisites for the formation of accounting depreciation policy; selection of appropriate depreciation methods; ensuring the intended use of depreciation.

Depreciation policy at the state level (macro level) should be aimed at effective management of the formation and use of depreciation resources in order to streamline the investment process to increase the welfare of the state. Based on the depreciation policy of the state, each business entity must develop and implement its own depreciation policy (micro level) to manage the process of sustainable formation and use of depreciation deductions to intensify investment activities.

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