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FINANCIAL STRATEGY OF MANAGEMENT FOR MARKETING AND COMMUNICATION DESIGN IN SMART ECONOMY CONDITIONS

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Abstract
The purpose of the study is to assess the effectiveness of a financial strategy for marketing and communication design management in a smart economy. It is noted that the solution to the problem of assessing the financial strategy of marketing and communication design management in a smart economy is important in shaping a new type of national economy based on technology, new knowledge and innovation. It is noted that the chosen topic of our study has hardly been analysed in the works of domestic and foreign scientists. In view of the above, we propose a methodology for assessing the financial strategy of marketing and communication design management in a smart economy. On the basis of multifactor linear regression, the study of the influence of smart economy factors on the level of profitability of enterprises as a resultant indicator of financial strategic management for the past ten years has been conducted. Using the tools of different types of mathematical-statistical modelling, the forecasting of the level of financial management efficiency for 2024-2026 has been calculated.

Keywords: *finance, management, marketing, smart economy, profitability, investment, entrepreneurship, forecasting.*
JEL Codes: *G17, M31.*

Introduction

Clarification of modern problems of assessing the financial strategy of marketing and communication design management in a smart economy is important in the formation of a national economy of a new type based on technology, new knowledge and innovation. The Ukrainian economy is currently undergoing, without exaggeration, a global transformation in all sectors and industries. Most of these transformations are having adverse effects on economic processes and phenomena, which require immediate management intervention. Under such conditions, an effective and efficient policy of marketing and communication design management is able to reduce the negative impact of the external environment on economic

entities and the national economy as a whole. There is a need to improve the methodological evidence-based approaches to assess the effectiveness of the financial strategy for marketing and communication design management in a smart economy.

Literature review

The problem of evaluating and improving the financial strategy of marketing and communication design management in a smart economy has not been sufficiently addressed in scientific papers, by both domestic and foreign scholars. Separate elements of marketing evaluation, financial management, communication design analysis or comprehensive diagnosis of the smart economy are considered in detail. As an example, the study (Letaifa, S., 2015) considers the methodology of building smart cities. The authors proposed a strategy to improve the use of energy resources, healthcare, transport, education and services, which, according to the researchers, will balance social and economic development in the rapid urbanization of smart cities. The scientific paper (Granlund, M. et al., 2005) proposed a framework for management control in the new economy enterprises operating in the field of information and communication technologies and biotechnology. The authors assumed that research and development activities and the introduction of innovations require significant involvement of venture capital. A very interesting aspect of this research is the analysis of life cycle models and strategic management of corporate culture. Researchers (Aranchiy, V. et al., 2022) have proposed an integral indicator for assessing the effectiveness of management of the financial condition of business entities in Ukraine and determined the impact of capital investment, personnel costs and remuneration on it. Selected tools of modelling methodology proposed in the study can be used to evaluate the financial strategy of marketing and communication design management in a smart economy. The interrelation of the knowledge economy, technology, management and innovation is explored in detail in the work (Angelidou, M., 2015). It is determined that these key elements form the smart cities and progressive economies of the future. Basic assessment tools that can be used to analyse the financial strategy of marketing and communication design management in a smart economy are proposed in works (Prokopenko, O. et al., 2022; Mazur, N. et al., 2021; Sarc, R. et al., 2019; Gryshchenko, I. et al., 2021; Al Sharif, R. et al., 2022; Khodakivska, O. et al., 2022). A scientific paper (Ogiela, L. et al., 2014) proposes methods for semantic data analysis in a cognitive economy of a new type, allowing both local and global information management and supporting smart communications. The authors (Faheem, M. et al., 2018) proposed important components of an intelligent network with international standards and information technologies in the context of Industry 4.0. The need to form smart economies and evaluate them is suggested in (Chauhan, A. et al., 2021; Gretzel, U., et al., 2015; Neirotti, P., et al., 2014; Yan, Z., et al., 2023; Kędra, A. et al., 2023; Bulchand-Gidumal, J., 2022; Hilorme, T. et al., 2019; Kovtun, O., 2022). Thus, we can testify to the insufficient attention of scientists to the problems of evaluating and forming a financial strategy for managing marketing and communication design in the smart economy. These works partially consider the problem we study and do not analyse it from the perspective of a complex approach.

The purpose of the study is to evaluate the effectiveness of a financial strategy for marketing and communication design management in a smart economy Accordingly, the following objectives were defined: to propose a methodology for determining the effectiveness of financial strategy for marketing and communication design management in a smart economy; to investigate factors influencing the formation of a smart economy based on knowledge and innovation; to forecast the effectiveness of financial management.

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Methodical approach

The effectiveness of a financial strategy for marketing and communication design management in a smart economy can be assessed using qualitative and quantitative parameters. This is possible with the use of different methodologies. Immediately in our case, we will use quantitative characteristics. We have used modelling techniques with multifactor correlation and regression analysis to solve the tasks. Calculations of the efficiency of financial management were carried out with the use of the tools and functions "CORREL", "LINEST", "TREND", "FORECAST". For the analysis of time series and residual regression models, the Durbin-Watson criterion was calculated.

Results

The outcome of an effective financial strategy should be considered the value of the profitability ratio of the business entity. However, its value is influenced by a combination of factors characterising the level of marketing, the effectiveness of communication and the optimality of enterprise financial management. Moreover, there are complex interrelations between these factors, so their impact on profitability is complex, indicating synergies between finance, communication, marketing and the level of enterprise management. In our case, therefore, a broad base of modelling tools should be applied in order to best identify financial management strategy issues, taking into account the influence of many factors. Multi-factor correlation and regression modelling are appropriate for assessing the degree of influence on the result indicator of each of the factors involved. The classical multifactor linear production function looks like a dependence of the following type:

$$\hat{Y} = a_0 + a_1X_1 + a_2X_2 + \ldots + a_nX_n. \quad (1)$$

Based on a multivariate linear regression, we will investigate the impact of smart economy factors on the level of profitability of enterprises as a result indicator of financial strategic management over the past ten years. Factors and indicators will do the study and analysis. As an example of factors of a smart economy: the structure of wholesale goods turnover of wholesale trade enterprises; consumer price indexes on average; the volume of sold products (goods, services) of large, medium, small and microenterprises by types of economic activity; capital investments of enterprises; labour costs of enterprises by types of economic activity with the division to large, medium, small and micro enterprises. At the same time, we will consider the value of the level of profitability (unprofitability) of all activities of enterprises as a result indicator of strategic management and efficiency of entrepreneurial activity. Let us think of the mathematically labelled factors, the X variables as independent variables and the Y variable as the dependent variable:

X0 is a fictitious factor (to be taken into account when calculating the regression);

X1 - structure of wholesale turnover of wholesale trade enterprises, UAH million;

X2 - consumer price indices on average, %;

X3 - volume of sold products (goods, services) of large, medium, small and microenterprises by types of economic activity, UAH thousand;

X4 - capital investments of enterprises, UAH thousand;

X5 - labour costs of enterprises by type of economic activity with distribution to large, medium, small and micro enterprises, UAH thousand;

Y is the level of profitability (unprofitability) of all company operations, %.

For a more detailed correlation and regression modelling of the performance indicator, namely the profitability of enterprises and marketing, and communication design

management factors in a smart economy, data from business entities by their activities (2012-2021) were used, namely:

X31 - volume of products (goods, services) sold by large businesses, UAH thousand;

X32 - volume of products (goods, services) sold by medium-sized businesses, UAH thousand;

X33 - volume of products (goods, services) sold by small businesses, UAH thousand;

X331 - volume of products (goods, services) sold by micro-entrepreneurship subjects UAH thousand;

X51 - labour costs of enterprises of large businesses, UAH thousand;

X52 - labour costs of medium-sized enterprises, UAH thousand;

X53 - labour costs of small businesses, UAH thousand;

X531 - labour costs of micro entrepreneurs, UAH thousand;

the performance indicator:

Y1 - level of profitability (unprofitability) of large businesses, %;

Y2 - level of profitability (unprofitability) of medium-sized enterprises, %;

Y3 - level of profitability (unprofitability) of small businesses, %;

Y31 - level of profitability (unprofitability) of micro-entrepreneurs, %.

The calculations are performed using Microsoft Excel spreadsheets and built-in mathematical-statistical functions. The first step in modelling the multifactor linear function is to determine the pairwise coefficients using Microsoft Excel function «CORREL». In this case, classical indicators of the closeness of connection characterise the following values: less than 0,3 connection is weak; within 0,3-0,7 - average; more than 0,7-close; 1 - direct dependence and functional connection. Characterising obtained paired correlation coefficients, it should be noted that each of the factors has a significant impact on the level of profitability (unprofitability) of all activities of enterprises (tab. 1).

Table 1. Study on the impact of key smart economy factors on enterprise profitability, 2012-2021

Factors of influence on the level of profitability (unprofitability) of all activities of enterprises, % Y	Symbolic notation	Correlation coefficient, r	Characteristic
Structure of wholesale turnover of wholesale trade enterprises, UAH million, X1	r_{YX1}	0,88	The relationship between the factor and the indicator is direct and close
Consumer price indices on average 1992-2021, %, X2	r_{YX2}	0,63	The relationship between the factor and the indicator is direct, medium
Volume of products (goods, services) sold by large, medium, small and micro-enterprises by type of economic activity, UAH thousand, X3	r_{YX3}	0,75	The relationship between the factor and the indicator is direct and close
Capital investments of enterprises, thousand UAH. X4	r_{YX4}	0,83	The relationship between the factor and the indicator is direct and close
Labour costs of enterprises by type of economic activity with breakdown into large, medium, small and micro enterprises, UAH thousand, X5	r_{YX5}	0,73	The relationship between the factor and the indicator is direct, medium

**Source: calculated by the authors.*

It is obvious that the influence of the main factors of a smart economy on the level of profitability of enterprises as an outcome indicator of strategic management is significant, the pair correlation coefficients are quite high and qualitative. If we analyse pair correlation coefficients in more details, we can conclude that the least influence on the result indicator of

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level of profitability of enterprises has the value of the consumer price index average of 1992-2021, the correlation coefficient is 0,63, the connection between the factor and the indicator is direct, medium. But, contrary to the method of exclusion of the factor having the least influence on the indicator of efficiency, the factor of the smart economy under research - the consumer price index average of 1992-2021 will not be excluded from further econometric analysis of multifactor regression model and we shall carry out the analysis and forecasting of the level of smart economy profitability with five factors and the result indicator. It should be noted that further econometric study is based on the calculation of pairwise correlation coefficients.

As noted earlier, for a more detailed multi-factor correlation and regression analysis of the level of profitability of enterprises, as an outcome indicator of financial management, 2012-2021 we used the data of business entities by their activities, characterising their marketing, financial, economic and communication indicators. Therefore, we calculate pairwise correlation coefficients using the built-in statistical function "CORREL" according to the same algorithm as before (Table 2).

Table 2. Study of the impact of the main factors of the smart economy on the level of profitability of enterprises by type of activity as an output indicator of financial management, 2012-2021

Factors of influence on the level of profitability (unprofitability) of enterprises by type of activity, % Y	Symbolic notation	Correlation coefficient, r	Characteristic
Level of profitability (unprofitability) of large businesses, % Y1			
Structure of wholesale turnover of wholesale trade enterprises, UAH million, X1	r_{Y1X1}	0,80	The relationship between the factor and the indicator is direct and close
Consumer price indices on average 1992-2021, %, X2	r_{Y1X2}	0,64	The relationship between the factor and the indicator is direct, medium
Volume of products (goods, services) sold by large business entities, UAH thousand, X31	r_{Y1X31}	0,79	The relationship between the factor and the indicator is direct and close
Capital investments of enterprises, UAH thousand. X4	r_{Y1X4}	0,84	The relationship between the factor and the indicator is direct and close
Labour costs of enterprises of large enterprises, UAH thousand, X51	r_{Y1X51}	0,74	The relationship between the factor and the indicator is direct and close
Level of profitability (unprofitability) of medium-sized enterprises, %, Y2			
Structure of wholesale turnover of wholesale trade enterprises, UAH million, X1	r_{Y2X1}	0,73	The relationship between the factor and the indicator is direct and close
Consumer price indices on average 1992-2021, %, X2	r_{Y2X2}	0,62	The relationship between the factor and the indicator is direct, medium
Volume of products (goods, services) sold by medium-sized enterprises, UAH thousand, X32	r_{Y2X32}	0,70	The relationship between the factor and the indicator is direct and close
Capital investments of enterprises, UAH thousand. X4	r_{Y2X4}	0,82	The relationship between the factor and the indicator is direct and close
Labour costs of enterprises of medium-sized enterprises, UAH thousand, X52	r_{Y2X52}	0,68	The relationship between the factor and the indicator is direct, medium
Level of profitability (unprofitability) of small businesses, %, Y3			
Structure of wholesale turnover of wholesale trade enterprises, UAH million, X1	r_{Y3X1}	0,80	The relationship between the factor and the indicator is direct and close
Consumer price indices on average 1992-2021, %, X2	r_{Y3X2}	0,67	The relationship between the factor and the indicator is direct, medium
Volume of products (goods, services) sold by small businesses, UAH thousand, X33	r_{Y3X33}	0,75	The relationship between the factor and the indicator is direct and close

Capital investments of enterprises, thousand UAH. X4	r_{Y3X4}	0,85	The relationship between the factor and the indicator is direct and close
Labour costs of enterprises of small businesses, UAH thousand, X53	r_{Y3X53}	0,75	The relationship between the factor and the indicator is direct and close
The level of profitability (unprofitability) of microenterprises, %, Y31			
Structure of wholesale turnover of wholesale trade enterprises, UAH million, X1	r_{Y31X1}	0,82	The relationship between the factor and the indicator is direct and close
Consumer price indices on average 1992-2021, % , X2	r_{Y31X2}	0,69	The relationship between the factor and the indicator is direct, medium
Volume of products (goods, services) sold by micro-entrepreneurs, UAH thousand, X331	$r_{Y31X331}$	0,77	The relationship between the factor and the indicator is direct and close
Capital investments of enterprises, thousand UAH. X4	r_{Y31X4}	0,87	The relationship between the factor and the indicator is direct and close
Labour costs of enterprises of micro-entrepreneurship, UAH thousand, X531	$r_{Y31X531}$	0,78	The relationship between the factor and the indicator is direct and close

**Source: calculated by the authors.*

As before, the influence of the main factors of the smart economy on the level of profitability of enterprises by type of their activity as an outcome indicator of strategic management is significant, the pair correlation coefficients are high enough and of high quality. Only the factor of consumer price index in average 1992-2021 affects indirectly the resultant indicator of the level of profitability of enterprises by type of their activities. Next, we calculate and compare the coefficients of the equation, the coefficient of determination, Fisher's F-criterion, the value of the standard error of the data and the number of observations using the built-in statistical function "LINEST" (table 3).

Table 3. Results of data processing to determine the impact of the main factors of the smart economy on the level of profitability of enterprises as a result indicator of financial management, 2012-2021

Using the built-in Microsoft Excel spreadsheets statistical function LINEST										
Multivariate production linear regression of level of profitability (unprofitability) of the entire activity of enterprises, %. $Yr=-12,99+0,00005\ X_1-0,08\ X_2+0,000000008\ X_3+0,000000033\ X_4-0,000000027\ X_5$										
Regression parameters						The coefficient of determination R^2	Standard error	Observations	The calculated value F of the Fisher's test, Fcalculated	Table value F of Fisher's test, Ftable
a_0	a_1	a_2	a_3	a_4	a_5					
-12,99	0,00005	-0,08	-0,000000008	0,000000033	-0,000000027	0,83	4,28	10	4,04	0,15
Multifactor production linear regression of profitability (unprofitability) of large business entities, %. $Y_1r=5,18+0,000015\ X_1-0,164\ X_2+0,000000001\ X_{31}+0,000000032\ X_4-0,0000001\ X_{51}$										
5,18	0,0000150	-0,164	-0,000000001	0,000000032	-0,0000001	0,79	4,73	10	2,93	0,15
Multifactorial production linear regression of profitability (unprofitability) level of medium-sized enterprises, %. $Y_2r=-18,61+0,000051\ X_1+-0,021\ X_2+0,000000024\ X_{32}+0,000000042\ X_4-0,00000003\ X_{52}$										
-18,61	0,000051	-0,021	-0,000000024	0,000000042	-0,00000003	0,83	3,81	10	3,84	0,15
Multifactor production linear regression of profitability (unprofitability) of small businesses, %. $Y_3r=-101,66+0,000145\ X_1+0,265\ X_2+0,000000105\ X_{33}-0,000000043\ X_4+0,00000040\ X_{53}$										

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-101,66	0,000145	0,265	-0,000000105	-0,000000043	0,00000040	0,92	4,37	10	9,70	0,15
Multivariate production linear regression of the level of profitability (unprofitability) of micro-entrepreneurship, %. $Y_{31}r$=-107,14+0,000119 X_1+0,176 X_2+0,000000152 X_{331}+-0,000000047 X_4+0,00000139 X_{531}										
-107,14	0,000119	0,176	-0,000000152	-0,000000047	0,00000139	0,89	6,75	10	6,35	0,15
Using the Microsoft Excel Spreadsheet Data Analysis add-in										
Multivariate production linear regression of profitability (unprofitability) of the entire activity of enterprises, %. Yr=-12,99+0,00005 X_1-0,08 X_2+0,000000008 X_3+0,000000033 X_4-0,000000027 X_5										
Regression parameters						Coefficient of determination R^2	Standard error	Observation	The calculated value of Fisher's F-criterion, Fcalculated	Table value of Fisher's F test, Ftable
a_0	a_1	a_2	a_3	a_4	a_5					
-12,99	0,00005	-0,08	-0,000000008	0,000000033	-0,000000027	0,83	4,28	10	4,04	0,15
Multifactor production linear regression of profitability (unprofitability) of large business entities, %. Y_1r=5,18+0,000015 X_1-0,164 X_2+0,000000001 X_{31}+0,000000032 X_4-0,0000001 X_{51}										
5,18	0,0000150	-0,164	-0,000000001	0,000000032	-0,0000001	0,79	4,73	10	2,93	0,15
Multifactorial production linear regression of profitability (unprofitability) level of medium-sized enterprises, %. Y_2r=-18,61+0,000051 X_1+-0,021 X_2+0,000000024 X_{32}+0,000000042 X_4-0,00000003 X_{52}										
-18,61	0,000051	-0,021	-0,000000024	0,000000042	-0,00000003	0,83	3,81	10	3,84	0,15
Multifactor production linear regression of profitability (unprofitability) of small businesses, %. Y_3r=-101,66+0,000145 X_1+0,265 X_2+0,000000105 X_{33}-0,000000043 X_4+0,00000040 X_{53}										
-101,66	0,000145	0,265	-0,000000105	-0,000000043	0,00000040	0,92	4,37	10	9,70	0,15
Multivariate production linear regression of the level of profitability (unprofitability) of micro-entrepreneurship, %. $Y_{31}r$=-107,14+0,000119 X_1+0,176 X_2+0,000000152 X_{331}+-0,000000047 X_4+0,00000139 X_{531}										
-107,14	0,000119	0,176	-0,000000152	-0,000000047	0,00000139	0,89	6,75	10	6,35	0,15

**Source: calculated by the authors.*

So, the equation coefficients, coefficient of determination, Fisher's F-criterion, data standard error value and a number of observations of multifactor production regression of the level of profitability (unprofitability) of all business activities using the built-in statistical function "LINEST" were obtained. As can be seen, they coincide, i.e. methodologically, the specialists of business entities choose the most convenient and optimal way to calculate the main statistical factors. Characterising the coefficients of equations of the level of profitability (unprofitability) of all activities of enterprises, it is possible to observe their fluctuations from increasing to decreasing, which indicates the dynamic production processes of the subjects of activity of enterprises of different types. As a result of data processing, the general coefficients of determination of multifactor production linear regression of the level of profitability (unprofitability) of the subjects of activity of enterprises of different types are obtained:

multifactor production linear regression of the level of profitability (unprofitability) of all activities of enterprises, R^2 = 0.83, a close relationship between the selected factors of the smart economy and the outcome indicator, the variation of the level of profitability (unprofitability) of all activities of enterprises at 83.48% is determined by the studied factors

introduced in the correlation model, the selected factors have a significant impact on the indicator under study;

multifactor production linear regression of the level of profitability (unprofitability) of large businesses, R^2=0.79, a close relationship between the selected factors of the smart economy and the outcome indicator, the variation of the level of profitability (unprofitability) of large businesses by 78.54% is determined by the studied factors introduced in the correlation model, the selected factors have a significant impact on the indicator under study;

multifactor production linear regression of the level of profitability (unprofitability) of medium-sized enterprises, R2=0.83, a close relationship between the selected factors of the smart economy and the outcome indicator, the variation of the level of profitability (unprofitability) of medium-sized enterprises, at 82.77% is determined by the studied factors introduced in the correlation model, the selected factors significantly affect the indicator under study;

multifactor production linear regression of the level of profitability (unprofitability) of small businesses, R^2=0.92, a close relationship between the selected factors of the smart economy and the outcome indicator, the variation of the level of profitability (unprofitability) of small businesses by 92,38% is determined by the studied factors introduced in the correlation model, the selected factors significantly affect the indicator under study;

multifactor production linear regression of the level of profitability (unprofitability) of micro-entrepreneurship, R^2=0,89, a close relationship between the selected factors of the smart economy and the outcome indicator, the variation of the level of profitability (unprofitability) of micro-entrepreneurship by 88.82% is determined by the studied factors introduced in the correlation model, the selected factors have a significant impact on the indicator under study.

Regarding the standard error, in our case, we observe an insignificant value of the statistical error, which indicates a successful choice of smart economy factors and the level of profitability of enterprises as an effective indicator of financial management over the past ten years. The adequacy of the multifactor linear model of the level of profitability of enterprises both for the whole activity of enterprises and by types of their activities and further prediction of these indicators is evidenced by Fisher's F-criterion, the calculated value of which is higher than the tabulated value.

Next, we forecast the level of profitability of enterprises, both for all enterprises' activities and by type of activity for the period 2024-2026, predicting the main factors of the smart economy using the built-in statistical function “TREND”. (Tables 4,5).

Table 4. Forecasting the main factors of the smart economy, 2024-2026

Years	Structure of wholesale turnover of wholesale trade enterprises, UAH million, X1	Consumer price indices on average 1992-2021, % , X2	Volume of products (goods, services) sold by large, medium, small and micro-enterprises by type of economic activity, UAH thousand, X3	Capital investments of enterprises, UAH thousand. X4	Labour costs of enterprises by type of economic activity with breakdown into large, medium, small and micro enterprises, UAH thousand, X5
2024	3537767,21	107,74	16539401877	641545915,31	1119864036,51
2025	3769227,52	107,37	17672754756	681624418,30	1201470445,42
2026	4000687,84	107,01	18806107635	721702921,28	1283076854,32

**Source: calculated by the authors.*

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Table 5. Forecasting the main factors of the smart economy by type of enterprise activity, 2024-2026

Years	Volume of products (goods, services) sold by large, medium, small and micro-enterprises by type of economic activity, UAH thousand, X3				Labour costs of enterprises by type of economic activity, broken down into large, medium, small and micro enterprises. X5			
	large business entities, UAH thousand, X31	medium-sized enterprises, UAH thousand, X32	small business entities, UAH thousand, X33	of which are subjects of micro-entrepreneurship, UAH thousand, X331	large business entities, UAH thousand, X51	medium-sized enterprises, UAH thousand, X52	small business entities, UAH thousand, X53	of which are micro-entrepreneurs, UAH thousand, X531
2024	5493963371,65	6570730262,69	4474708242,24	2436109678,52	404535324,74	533271955,43	182056756,33	57881736,87
2025	5846369753,84	7022169651,96	4804215350,21	2621679179,25	432018689,14	574104303,41	195347452,87	62058554,74
2026	6198776136,02	7473609041,22	5133722458,19	2807248679,97	459502053,54	614936651,38	208638149,40	66235372,60

**Source: calculated by the authors.*

We note an increase in all major factors influencing the level of enterprise profitability as a management result indicator for the 2024-2026 period, which is a justified and logical economic process.

Consequently, the profitability of enterprises as an indicator of financial management in general and by type of activity has increased (Table 6).

Table 6. Forecasting the level of profitability of enterprises as an output indicator of financial management in general and by types of their activities, 2024 2026.

Years	Level of profitability (unprofitability) of the entire activity of enterprises, % Y				
	of all activities of enterprise, % Y	large business entities, %, Y1	medium-sized enterprises, %, Y_2	small business entities, %, Y_3	of which are micro-entrepreneurs, %, Y_{31}
2024	12,73	13,82	11,19	14,43	14,46
2025	14,35	15,44	12,53	16,84	17,76
2026	15,97	17,06	13,88	19,24	21,07

**Source: calculated by the authors.*

Graphically, the multifactorial production linear regression of the level of profitability (unprofitability) of all activities of enterprises, large enterprises, medium-sized enterprises, small enterprises and microenterprises is presented in Figs. 1, 2, 3, 4, 5, which show the actual, theoretical, and forecast values of these performance indicators, 2012-2021, 2024-2026.

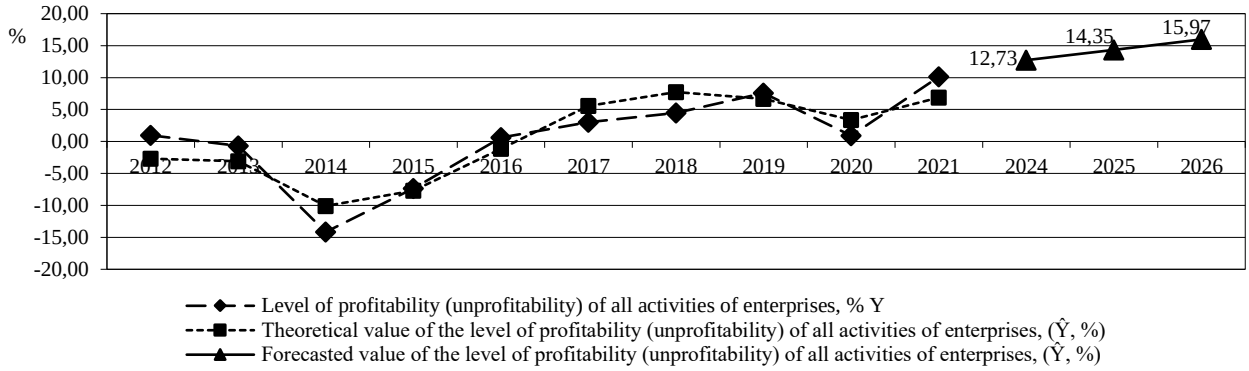

Figure 1. Actual, theoretical, and forecasted values of the level of profitability (unprofitability) of all enterprises' activities, 2012-2021, 2024-2026

**Source: compiled by the authors.*

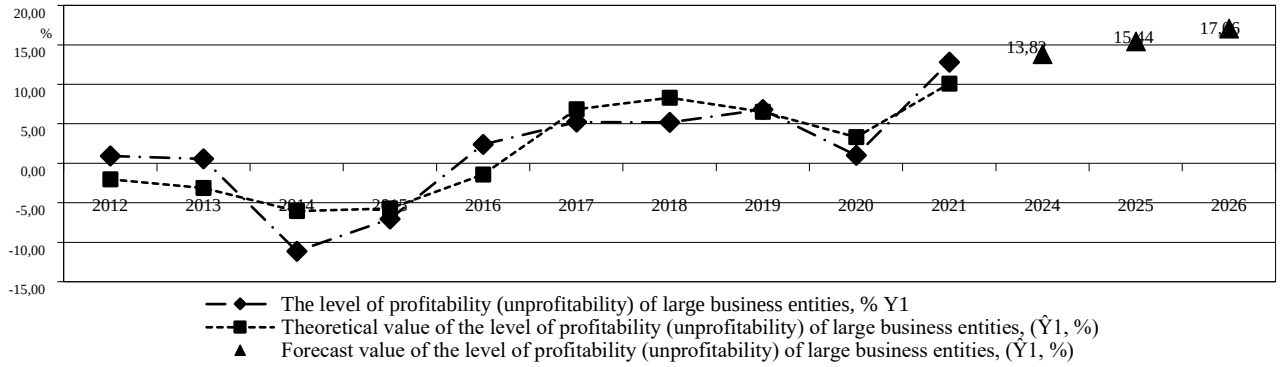

Figure 2. Actual, theoretical, and forecasted values of the level of profitability (unprofitability) of large business entities, 2012-2021, 2024-2026

**Source: compiled by the authors.*

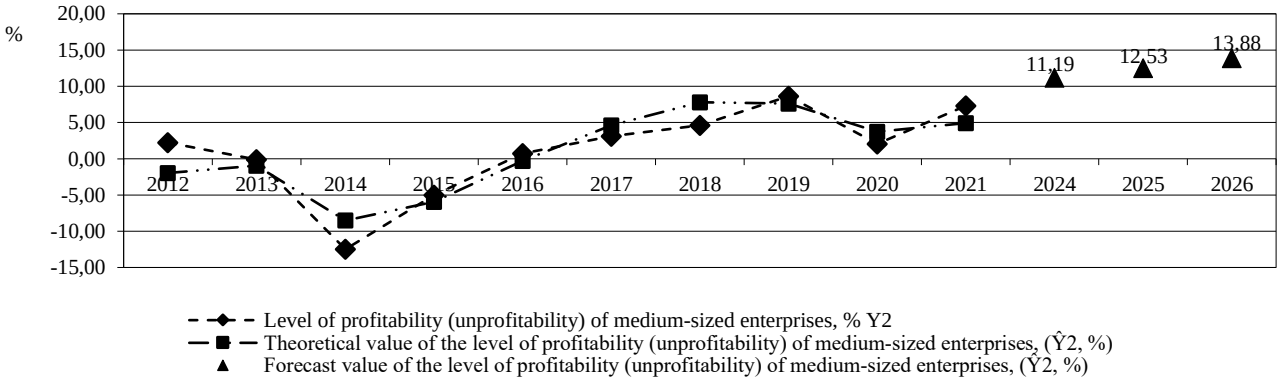

Figure 3. Actual, theoretical, and forecast values of the level of profitability (loss) of medium-sized enterprises, 2012-2021, 2024-2026

**Source: compiled by the authors.*

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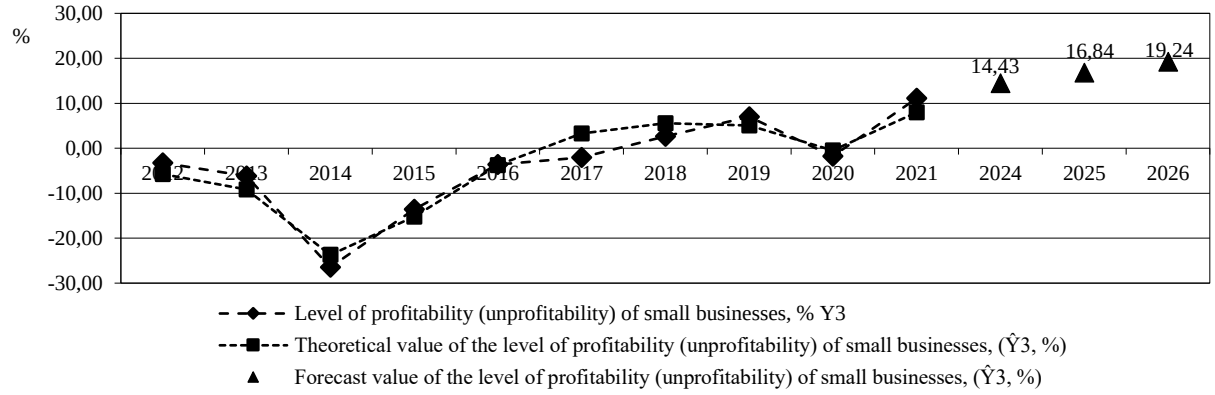

Figure 4. Actual, theoretical, and forecast values of the level of profitability (unprofitability) of small businesses, 2012-2021, 2024-2026

**Source: compiled by the authors.*

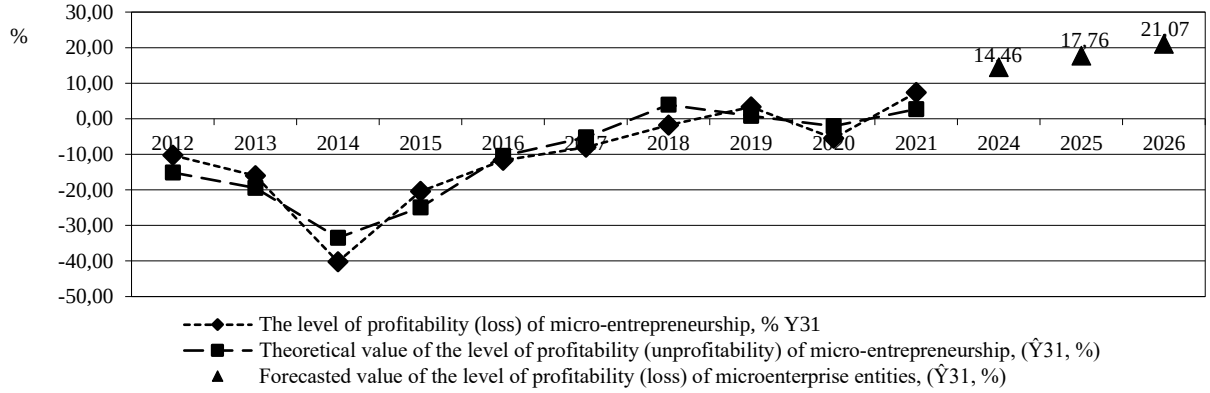

Figure 5. Actual, theoretical, and forecasted values of the level of profitability (loss) of microenterprises, 2012-2021, 2024-2026

**Source: compiled by the authors.*

So, as a result of the first part of the study of multifactor production linear regression of the level of profitability (unprofitability) of all activities of enterprises, subjects of large businesses, medium businesses, small businesses and micro-entrepreneurship subjects, we can see a significant impact of the main factors of smart economics as the latest technology of studying complex dynamic phenomena at the macro-, meso- and macrolevels. The next stage of the study is the analysis of the regression model with auto-correlated residuals and analysis of the regression model after autoregressive transformation, using the Durbin-Walson test, regression residuals analysis, prediction, comparison of the productive indicator of the level of profitability of enterprises, as an indicator of financial management, 2012-2021. As a starting point for this study, we took the net profit (loss) factor as an element of the smart economy and the resultant indicator - the level of profitability (unprofitability) of all enterprise activities. We understand that the relationship between these variables is directly proportional, high and linear, but the purpose of this analysis

is to calculate with the help of another econometric method using regression models, the prediction of the resulting indicator of the level of profitability (unprofitability) of all activities of enterprises, comparing the results and proposal for use in the real economy of enterprises. Dynamics of net profit (loss) and profitability (unprofitability) level of all activities of the enterprise over the last ten years is presented in Table 7, where the mathematically denoted factor, variable X is the independent variable and indicator variable Y is the dependent variable.

Table 7. Dynamics of net profit (loss) as an element of the smart economy and the level of profitability (unprofitability) of all activities of enterprises as a result indicator of strategic management, 2012-2021

Years	Net profit (loss), UAH thousand, X	Level of profitability (unprofitability) of all activities of enterprises, % Y
2012	35067276,80	0,97
2013	-22839743,60	-0,70
2014	-590066944,50	-14,16
2015	-373516013,20	-7,33
2016	29705020,10	0,61
2017	168752792,70	3,04
2018	288305468,10	4,47
2019	523779001,50	7,59
2020	68054905,50	0,92
2021	885276479,50	10,11

**Source: https://www.ukrstat.gov.ua/.*

The calculations are performed using Microsoft Excel spreadsheets, built-in statistical, mathematical functions, arrays and the "Data Analysis of Microsoft Excel Spreadsheets" add-in. As a result of data processing, we obtained basic statistical coefficients: coefficients of production linear regression of level of profitability (unprofitability) of all enterprises activities, correlation coefficient, coefficient of determination, standard error value, Fisher`s F-criterion, Student's test, residuals of production regression, the theoretical value of profitability (unprofitability) level of all enterprises activities, chart of residual values of the result indicator, 2012-2021:

a_0= -1,096;

a_1= 0,0000000163.

Production linear regression of the level of profitability (unprofitability) of all activities of enterprises: Y =-1,096+0,0000000163 X+ ε. Correlation coefficient r=0.97, direct correlation, close connection between the factor of net profit (loss) as an element of the smart economy and the level of profitability (unprofitability) of all activities of enterprises. Determination coefficient R^2=0.93, direct correlation, close connection between the factor of net profit (loss) as an element of smart economy and the level of profitability (unprofitability) of all activities of enterprises, the variation of the result indicator by 93.20% is determined by the investigated factor introduced in the correlation model, the selected factor has a significant impact on the indicator under study. The standard error is 1.94. Value of Fisher`s F-criterion: tabulated 5.12; calculated 109.70. Student's t-test value: tabular 0.46; calculated 10.47.

The production linear regression of the level of profitability (unprofitability) of all

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enterprise activities is adequate to the input data, qualitative, as evidenced by Fisher's F-criterion, the calculated value of which is greater than the table one. The value of the Student's t-test testifies to the significance of the correlation coefficient because its calculated value is greater than the tabulated one. The theoretical value of the level of profitability (unprofitability) of all activities of enterprises and the derivation of the residual indicator using the add-in "Data Analysis of Microsoft Excel Spreadsheets" is presented in Table 8.

Table 8. Theoretical value of the level of profitability (unprofitability) of all activities of enterprises and derivation of the residuals of the performance indicator, 2012-2021

Years	Forecast (Theoretical value of the level of profitability (unprofitability) of the entire activity of enterprises, % Y)	Residuals
2012	-0,53	1,49
2013	-1,47	0,77
2014	-10,69	-3,47
2015	-7,17	-0,17
2016	-0,61	1,22
2017	1,65	1,39
2018	3,59	0,88
2019	7,42	0,17
2020	0,01	0,91
2021	13,30	-3,19

**Source: calculated by the authors.*

The graph of the residuals of the level of profitability (unprofitability) of the entire activity of enterprises, 2012-2021, is shown in (Fig. 6).

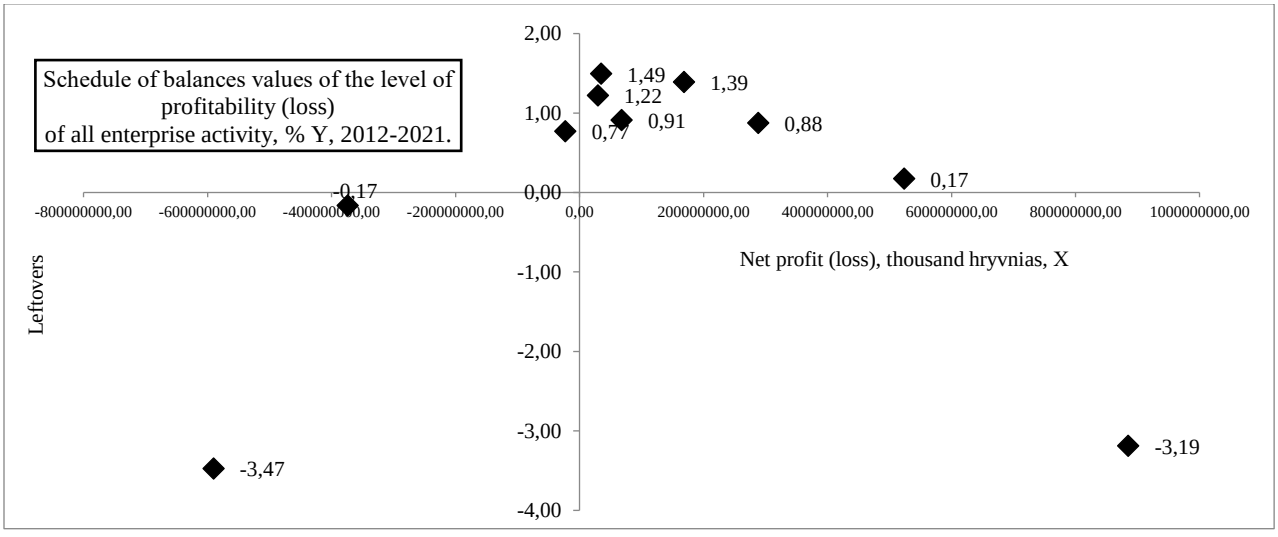

Figure 6. Graph of residual values of the level of profitability (unprofitability) of all activities of enterprises, 2012-2021

**Source: calculated by the authors.*

We calculate the value of DW - Durbin-Watson statistics and use it to analyse the presence of autocorrelation, while making further calculations (Table 9).

Table 9. Theoretical value of the profitability (unprofitability) level of all business activities, the residual profitability (unprofitability) of all business activities and additional calculations, 2012-2021

Years	Prediction (Theoretical value of the level of profitability (unprofitability) of all activities of enterprises, % Y	Residuals	$(E_i - E_{i-1})^2$	Ei^2
2012	-0,53	1,49		2,23
2013	-1,47	0,77	0,52	0,59
2014	-10,69	-3,47	17,99	12,07
2015	-7,17	-0,17	10,94	0,03
2016	-0,61	1,22	1,92	1,49
2017	1,65	1,39	0,03	1,93
2018	3,59	0,88	0,26	0,77
2019	7,42	0,17	0,49	0,03
2020	0,01	0,91	0,54	0,83
2021	13,30	-3,19	16,79	10,16
		Sum	49,50	30,11

**Source: calculated by the authors.*

The critical values of the Durbin-Watson statistics in our case are the lower critical value of d1=0.88 and the upper critical value d2=1.32. The value of the DW-statistic under study, equal to 1.64, is greater than d2=1.32, therefore, there is no positive autocorrelation in the regression residuals of the level of profitability (unprofitability) of all activities of enterprises. Since the test`s statistic is 1.64 and does not lie within this range, there is insufficient evidence to rule out the null hypothesis of the Durbin-Watson test, in other words, there is no correlation between the residuals. Since, under autocorrelation conditions of the residuals regression of level of profitability (unprofitability) of the entire operations of enterprises may be made incorrect qualitative conclusions about the presence of a linear relationship between the regressor of net income (loss) and the regressor of the level of profitability (unprofitability) of the entire operations of enterprises, then on the basis of the correlation coefficient, coefficient of determination, F-statistics and t-statistics, which were calculated in advance, the results can be argued that there is a positive relationship between the net income (loss) and the level of profitability (unprofitability) of the entire operations of enterprises For further analysis of the production linear regression of the level of profitability (unprofitability) of the entire enterprise activity, an autoregressive transformation should be performed, in which $\rho=1$ according to the preliminary method, using additional calculations for the autoregressive transformation (Table 10).

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Table 10. Dynamics of net profit (loss) as an element of the smart economy and the level of profitability (unprofitability) of all activities of enterprises as a result indicator of financial management and additional calculations for autoregressive transformation 2012-2021

Years	Net profit (loss), UAH thousand, X	Level of profitability (unprofitability) of the entire activity of enterprises, % Y	Level of profitability (unprofitability) of the entire activity of enterprises, % Y*=Yi-Yi-1	Net profit (loss), thousand UAH X*=Xi-Xi-1
2012	35067276,8	0,967		
2013	-22839743,6	-0,699	-1,67	-57907020,40
2014	-590066944,5	-14,163	-13,46	-567227200,90
2015	-373516013,2	-7,334076	6,83	216550931,30
2016	29705020,1	0,607113	7,94	403221033,30
2017	168752792,7	3,036535	2,43	139047772,60
2018	288305468,1	4,46721	1,43	119552675,40
2019	523779001,5	7,592368	3,13	235473533,40
2020	68054905,5	0,920853	-6,67	-455724096,00
2021	885276479,5	10,109957	9,19	817221574,00

**Source: calculated by the authors.*

As before, using the add-in "Data analysis of spreadsheets Microsoft Excel", the main statistical coefficients for autoregressive transformation were obtained: the coefficients of the production linear regression of the adjusted value of the level of profitability (unprofitability) of all enterprises activities, the correlation coefficient, determination coefficient, standard error value, Fisher`s F test, Student's test, residuals of production regression, the theoretical value of the adjusted level of profitability (unprofitability) of all activities of enterprises, the graph of residuals of the output indicator values, 2012-2021: a_0= -0,54; a_1= 0,0000000165. Production linear regression of the adjusted level of profitability (unprofitability) of all enterprises after autoregressive transformation: Y= -0,54+0,0000000165 X+ ε.

Correlation coefficient r=0.94, direct correlation, close relationship between the factor of net profit (loss) as an element of the smart economy and the level of profitability (unprofitability) of all activities of enterprises. Coefficient of determination R^2 = 0.89, direct dependence, close connection between the factor of net profit (loss) as the element of smart economy and level of profitability (unprofitability) of all activity of enterprises, the variation of the result indicator by 89.09% is determined by the investigated factor, introduced into the correlation model, the chosen

factor has a significant impact on the indicator under study. The standard deviation is 2.59. Value of Fisher's F-criterion: tabular 5,32; calculated 57,19. Value of Student's criterion: tabular 0.52; calculated 7.56.

Production linear regression of the level of profitability (unprofitability) of all activities of enterprises after autoregressive transformation is adequate to the input data, qualitative, as evidenced by Fisher's F-criterion, the calculated value, more than the tabulated one. The value of the Student's t-test testifies to the significance of the correlation coefficient because its calculated value is greater than the tabulated one. The graphical analysis of the residual values of the level of profitability (unprofitability) of all operations, 2012-2021 after the autoregressive transformation with the use of the add-on "Data Analysis of Microsoft Excel Spreadsheets" is shown in Fig. 7.7.

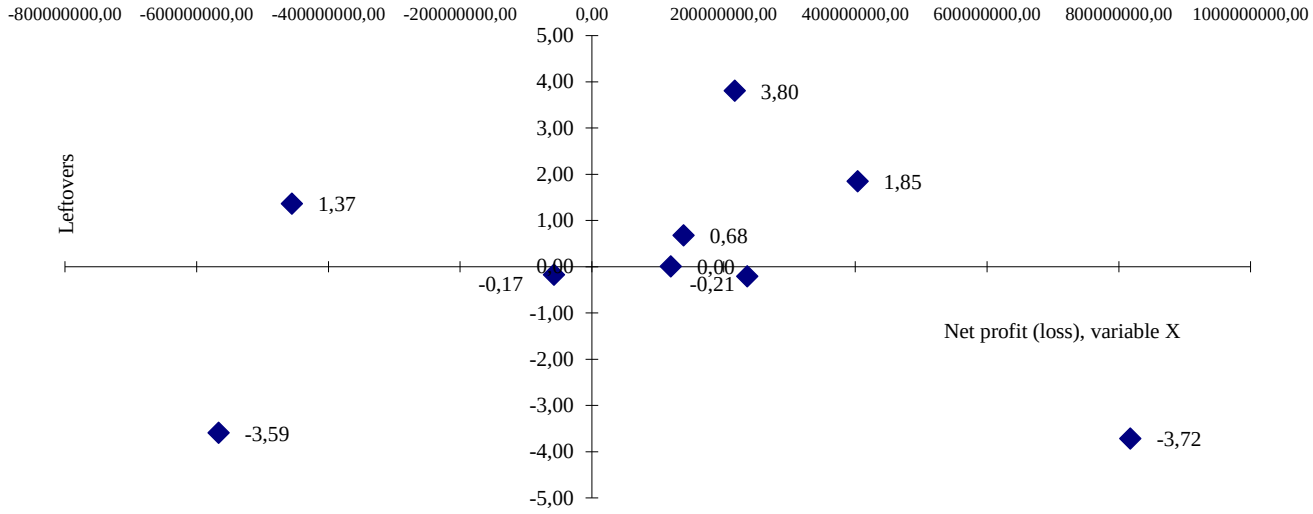

Figure 7. Graph of residual values of the level of profitability (unprofitability) of all operations after autoregressive transformation, 2012-2021

**Source: calculated by the authors.*

To calculate the values of the Durbin-Watson DW statistic, further calculations are required (Table 11).

Table 11. Theoretical value of profitability (unprofitability) of all enterprises activity after the autoregressive transformation, derivation of the residual profitability (unprofitability) level of all business activities and additional calculations, 2012-2021.

Years	Prediction (Theoretical value of the level of profitability (unprofitability) of the entire activity of enterprises after autoregressive transformation)	Residuals	$(E_i - E_{i-1})^2$	E_i^2
2012				
2013	-1,49	-0,17	0,03	0,03
2014	-9,87	-3,59	11,68	12,91
2015	3,02	3,80	54,72	14,47
2016	6,10	1,85	3,84	3,40
2017	1,75	0,68	1,36	0,46

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2018	1,43	0,00	0,46	0,00
2019	3,34	-0,21	0,05	0,04
2020	-8,04	1,37	2,48	1,86
2021	12,91	-3,72	25,84	13,83
		Sum	100,46	47,01

**Source: calculated by the authors.*

We calculate the Durbin-Watson DW-statistic after applying the autoregressive transformation DW=2.14. The critical values of the Durbin-Watson statistic after the autoregressive transformation are d1=0.82 and d2=1.32. Therefore, the calculated value of the DW statistic after the autoregressive transformation, equal to 2.14, is greater than d2=1.32; therefore, there is no autocorrelation in the regression residuals.

So, to summarise. Received:

production linear regression of the level of profitability (unprofitability) of all enterprises with auto-correlated residuals

$Y = -1,096+0,0000000163\ X+ \varepsilon;$

production linear regression of the level of profitability (unprofitability) of the entire activity of enterprises after the autoregressive transformation

$Y = -0,54+0,0000000165\ X+ \varepsilon.$

If the initial model of regression of the level of profitability (unprofitability) of all enterprises activity with autocorrelated residuals showed, that increase of net income (loss) by 1 thousand UAH leads to an increase of profitability level of all enterprises activity on 0.0000000163%, then after autoregressive transformation, the model effective (with the least variance) estimate of the regression coefficient shows, that increase of net income (loss) by 1 thousand UAH leads to an increase of profitability level of all enterprises activity on 0,0000000165%. The author's contribution is forecasting the level of financial management expressed in terms of production profitability, defined by production linear regressions with autocorrelated residuals and autoregressive transformations for the next period 2024-2026. Graphical representation and comparison of forecast values of financial management determined by various economic and mathematical methods and models, determination of the most qualitative representation are presented in Table 12, Fig. 8, Table 13.

Table 12. Actual, theoretical and predicted values of financial management level issued by production linear regressions with autocorrelated residuals and autoregressive transformations, 2012-2021, 2024-2026

Years	Net profit (loss), thousand hryvnias, X	The level of profitability (unprofitability) of all enterprise activities, % Y	The theoretical value of the level of profitability (loss) of all enterprise activities, (Ŷ, %) Production linear regression Y = -1,096+0,0000000163X+ε.	The theoretical value of the level of profitability (loss) of all enterprise activities, (Ŷ, %) Production linear regression Y = 0,54+0,0000000165X+ε.	The forecast value of the level of profitability (unprofitability) of all enterprise activities, (Ŷ, %) Production linear regression Y = -1,096+0,0000000163X+ε.	The forecast value of the level of profitability (unprofitability) of all enterprise activities, (Ŷ, %) Production linear regression Y = 0,54+0,0000000165X+ε.
2012	35067276,80	0,97	-0,53	0,04		
2013	-22839743,60	-0,70	-1,47	-0,91		
2014	-590066944,50	-14,16	-10,69	-10,25		
2015	-373516013,20	-7,33	-7,17	-6,68		

2016	29705020,10	0,61	-0,61	-0,05		
2017	168752792,70	3,04	1,65	2,24		
2018	288305468,10	4,47	3,59	4,21		
2019	523779001,50	7,59	7,42	8,08		
2020	68054905,50	0,92	0,01	0,58		
2021	885276479,50	10,11	13,30	14,03		
2024	827701247,68				12,36	13,08
2025	924561170,79				13,94	14,67
2026	1021421093,91				15,51	16,27

**Source: Projection figures calculated by the authors.*

It should be noted that the prediction of net profit (loss) for the next period 2024-2026 was made by the built-in statistical function "FORECAST", the value of this factor increasing, is a justified trend. We note an increase in the level of financial management efficiency determining production linear regressions with autocorrelated residuals and autoregressive transformations, 2024-2026.

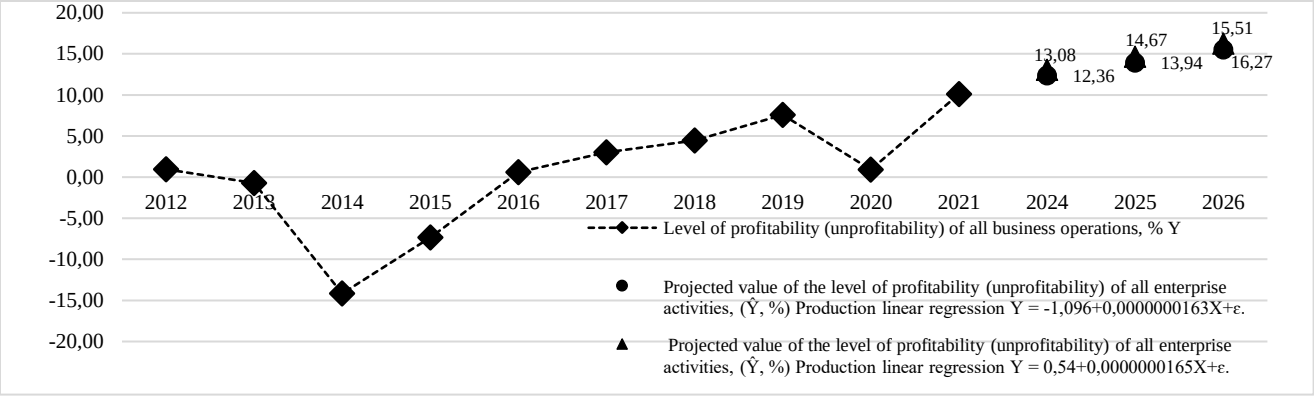

Figure 8. Actual and predicted values of the level of financial management efficiency, issued by production linear regressions with adjusted residuals and autoregressive transformations, 2012-2021, 2024-2026

**Source: calculated by the authors.*

Table 13. Comparative characteristics of forecast values of the level of financial management efficiency determined by various economic and mathematical methods and models, 2024-2026

Years	Predicted value of the level of profitability (unprofitability) of all enterprises' activities, (Ŷ, %) Production linear regression Y = -1.096+0.0000000163X+ε.	Predicted value of the level of profitability (loss) of all activities of enterprises, (Ŷ, %) Production linear regression Y = 0,54+0,0000000165X+ε.	Predicted value of the level of profitability (loss) of all activities of enterprises, (Ŷ, %) Multivariate production linear regression Yr = -12,99+0,00005X_1-0,08X_2+0,000000033X_4-0,000000027X_5
2024	12,36	13,08	12,73
2025	13,94	14,67	14,35
2026	15,51	16,27	15,97

**Source: calculated by the authors.*

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Thus, the described methodology for assessing the financial strategy of marketing and communication design management in a smart economy is a tool for monitoring the development of smart economies. The results can serve as a benchmark for timely management decision-making by public administrators, business entities or other market stakeholders seeking to develop a knowledge and innovation-based economy.

Conclusions

Thus, the authors have proposed a methodology for assessing the financial strategy of marketing and communication design management in a smart economy. Based on multifactor linear regression the study of the impact of smart economy factors on the level of profitability of enterprises, as a performance indicator of financial strategic management for the past ten years has been conducted. Forecasting of the main factors of the smart economy, 2024-2026 has shown the increase of indicators of the structure of wholesale trade turnover of wholesale trade enterprises, volumes of sales by subjects of entrepreneurial activity, capital investments of enterprises, expenses on wages of enterprises. Our next research will focus on modelling the integral indicator of financial strategy effectiveness of marketing and communication design management in a smart economy using the tools of artificial intelligence.

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