Modelling of Development of Hotel Business Potential and Economic Growth in Ukraine

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Abstract
The use of machine learning algorithms to increase efficiency and achieve business goals is a pressing issue in the modern era. The purpose of this paper is to develop an econometric model of the factors influencing the potential of the hotel industry for economic growth in Ukraine and its practical implementation. It was found that the main indicators characterizing the potential of the hotel industry and influencing the economic development of Ukraine are income from hotels services provided and similar accommodation, operating and other costs of hotels and similar accommodation, the living area of all hotel rooms and similar accommodation, the fixed asset's degree of depreciation. The developed model allowed us to identify the components of the hotel business potential that can contribute to the increase of GDP and predict the growth of Ukraine. The obtained results show that the level of Ukraine's GDP is expected to decrease gradually in the future. The calculations indicate that stimulating the growth of the hotel business will have a positive impact on the growth of Ukraine's GDP. Therefore, the application of machine learning methods can facilitate well-informed decisions regarding the future activities of the hotel business.

Keywords [1]
Machine learning, Econometric Modelling, Hotel Business, Potential, GDP, Economic Growth, Development, Components

1. Introduction

The modern marketplace requires businesses to use appropriate information technology to stay ahead of their competitors. Machine learning has proven its effectiveness in developing directions for business development. Companies are successfully using machine learning tools to predict customer churn, and hiring processes, identify business trends, create an almost infinite number of advertising messages, automate routine tasks, and more [1; 2]. From a research perspective, it is important to consider machine learning through the prism of econometric modelling of the development of hotel business potential and economic growth.

In today's conditions, in the course of globalization processes, the national market of hotel services has experienced and is still experiencing significant transformations. This situation is mainly due to the difficult competitive conditions, the ability to effectively use the potential, and the growing hotel

business dependence on innovation, modern technologies, and developments. Foreign investment inflows and the country's social, economic, and political situation have a significant efficiency growth impact on the performance indicator in the hotel business.

A key indicator of the hotel business's impact on social and economic development is the contribution of the hotel business to the GDP of Ukraine. The hotel industry development in the country causes GDP growth. Despite periodic shocks, pandemics, and global crises for more than half a century, the hospitality and hotel industry continues to survive and develop [3]. In the context of the hospitality industry, the hotel business performs its main functions, as it creates and offers consumers a range of services, in suggestion and provision of which all sectors and components of the hospitality industry are involved. Tourists bring money to the country, helping to create workplaces, filling local and state budgets, and attracting investors [4]. However, in recent years, the hotel business in Ukraine tends to stagnate, and difficult competition with various external problems and more competitive global tourism segments. Identifying the potential components of the hotel business that determine the country's development and economic growth is an urgent task [5].

In modern economic conditions, the problems of formation and effective use of the potential opportunities of the hotel business occupy a special place, and the management of the potential of the hotel business and the justification of measures for its development to increase efficiency and competitiveness are of interest to both to scientists and practitioners. It is important to identify the elements of the potential of the hotel business that affect the economic development of the country and to establish quantitative and qualitative relations between individual components of the business development potential.

The paper aims to develop a factor econometric model influencing hotel business potential on economic growth in Ukraine and its practical approbation. Namely, to determine the components that have the maximum impact on the country's GDP.

In the process of research, it was established that the main indicators that characterize the potential of the hotel business and have an impact on the economic development of Ukraine are: income from hotels services provided and similar accommodation, operating and other costs of hotels and similar accommodation, the living area of all hotel rooms and similar accommodation, the fixed asset's degree of depreciation.

In the process of creating an econometric model, the following tasks were set.

- To analyze the degree of influence of the components of the hotel business potential on the country's GDP;

- to clarify the degree of change in the characteristics of hotel business potential and GDP growth are changing;

- to formulate conclusions on the development of hotel business potential and economic growth in Ukraine;

- to forecast changes in economic growth in Ukraine.

2. Related Works

Machine learning methods and econometric models allow using calculations' results in planning to ensure the scientific validity and plan optimization. Econometric methods - correlation and regression analysis - allow to obtain quite acceptable results in the current market conditions of the economy World and domestic experience has accumulated a considerable amount of knowledge about modelling and forecasting of economic processes. However, the search for development and improvement of methods, which would allow analysing and forecast of all economic processes by market development conditions and transformational conversion, continues in Ukraine to this day. Studying modern society processes for building an econometric model requires gathering all information about indicators, resources, and potential [6].

The results of modelling and forecasting allow to create and develop roadmaps for the development of economic spheres, especially the national economy, within the framework of social and economic development of regions and state programmes.

The econometric modelling tools used in the market economy have a certain impact on all hierarchical levels of the national economy. The development of machine learning methods, in particular, econometric models requires understanding that the basis of the modelling process is the analysis of quantitative data

describing the economic phenomenon, daily qualitative features applied to the modelling as far as possible their previous growth as indicators of economic development [7].

An important and effective machine learning tool is econometric modelling. This tool is used to study the development of economic events, phenomena, and situations, and to forecast economic processes for the future, taking into account the trends of all hierarchical levels of the national economy.

Considering econometric modelling as a process, it is advisable to highlight the following points in its organization: collection and study of the information on the phenomenon and process characteristics; establishment of rules for creating an econometric model; analysis and economic interpretation of the model qualities; transition from abstract information to real conditions or phenomena in the model. An econometric modelling process organizing can be divided into several procedures: preliminary economic analysis to develop econometric models; creation of an abstract model, collection, accumulation, and processing of information; construction of a working model; testing of the working model and its adjustment; mathematical calculation of the model; determination of parameters and values of variables; economic analysis of the results.

The activity of the hotel business has its own characteristics, which are formed under the influence of potential. The development of the potential of the hotel business is one of the priority directions of the development of the tourism industry, which has a significant impact on the efficiency of the tourism industry and the social and economic development of Ukraine.

According to Judina [8], in management, it is important to use the most accurate methods of mathematical and statistical analysis, which ensure the forecasting of activity results and optimization of management decisions. Achieving the target results requires analysis and assessment of the potential, establishing the necessary parameters, and structuring them in the given direction of development according to the established methodology.

In Wang's opinion [9], ensuring such business development is possible due to the ability to use potential and increase the volume of production and sales of products, provided that the efficiency of using available resources is increased and the degree of influence of external factors on the conditions of the enterprise's activity is observed in compliance with the principles of its efficiency. The author investigated the impact of income from services and various expenses on business efficiency. In the competitive market of hospitality services, the desire of the hotel business to obtain more profit and the growing demands of service consumers prompt the hotel business to provide not only accommodation and food but also to expand the scope of additional and related services. This enriches the activity of the hotel business and expands the scope of activities of hotel enterprises that provide services for their products and related industries. This confirmed the need to include the indicator «income from hotels services provided and similar accommodation» in the model.

Koval et al. [10] examine internal potential and factors (such as fixed assets) and identify individual resource components, the effective management of which can ensure economic development. Fixed assets are used for a long period of time and their cost can have a significant impact on the indicators of the company's financial condition. The problem of the effective use of fixed assets in the hotel business in Ukraine is very urgent. Fuller use of labour resources leads to a reduction in the need to put new production facilities into operation, to an increase in production volume and an increase in the level of its quality (and therefore profit), accelerates their turnover, which significantly contributes to solving the problem of reducing the gap in terms of physical and moral depreciation, accelerates the pace of renewal of fixed assets.

Khalil, Kakar, and Malik [11] note that economic development is provided by analyzing the relationships between the structural elements of the potential, which allows identifying the directions of business development and economic growth of enterprises and the GDP of the country. The authors note that operating and other costs of hotels and similar accommodation facilities are important qualitative indicators of hotel activity, which affects both the general results of economic activity and the cost of certain types of hotel services.

In this regard, the need to improve planning and save hotel operating costs in the hotel business may come to the fore. In all planning solutions, the main structural element of the residential floor is the room. The concentration of modern hotels in large cities leads to an increase in the average room size and the average area. The change in the number of rooms in hotels, as well as the living space of their rooms, depends on the type of hotel, status, etc. The living area of all hotel rooms and similar accommodations is one of the indicators used to determine a hotel's star rating.

In this study, the use of econometric modelling in the forecasting of the country's economic growth will be demonstrated. The country's GDP was chosen as the economic growth indicator.

3. Methods

It is necessary to build a forecast function for all determined model factors to implement the GDP forecast due to the developed econometric model. To create an econometric model, an analysis of statistical data characterizing the hotel business in Ukraine for the period from 2012 to 2021 years is carried out [10]. The factors that shape the potential of the hotel business were selected. As a result of the analysis, an econometric dependence is obtained:

$$Y = a_1 + a_2 x_1 + a_3 x_4,$$ (1)

$$x_1 = a_4 + a_5 x_2 + a_6 x_3,$$

where Y – GDP amount, million UAH;

x_1 is income from hotels services provided and similar accommodation, million UAH;

x_2 is operating and other costs of hotels and similar accommodation, million UAH;

x_3 is the living area of all hotel rooms and similar accommodation, sqm;

x_4 is the fixed asset's degree of depreciation, %;

a_1, a_4 are free terms of equations;

a_2, a_3, a_5, a_6 are computational coefficients of the regression equation.

The multifactor model values appear in the role of the estimated parameters and reflect the independent contributions of each independent variable in the dependent variable forecasting.

The econometric model parameters are set based on the statistical data presented in Table 1. The study used the multiple regression functions of the Statistica application package which allows for determining the influence indicator degree on the object by the method of step-by-step multifactor analysis [13]. The generalizing indicator that characterizes the socio-economic growth of the state is GDP - the most common indicator that reflects the state of economic development and is the total market value of all final goods and services produced by economic residents of the country in its territory for a certain period. Firstly, we will develop an econometric model for forecasting hotel services provided income, and similar accommodation and conduct an economic analysis of the results.

Table 1
Estimating statistics for the econometric model

Years	GDP amount, million UAH (y)	Income from hotels services provided and similar accommodation, million UAH (x1)	Operating and other costs of hotels and similar accommodation, million UAH (x2)	The living area of all hotel rooms and similar accommodation, sqm (x3)	The fixed asset's degree of depreciation, % (x4)
2012	1082568	3423,63	3981	1700,59	74,90
2013	1316601	3608,77	4043	1624,60	75,90
2014	1408889	4486,85	4182	1805,31	76,70
2015	1454932	4957,52	4250	1996,11	77,30
2016	1566729	5012,44	4334	1604,79	83,50
2017	1979458	5112,15	5892	1338,50	60,10
2018	2383183	6710,17	5640	2187,40	58,10
2019	2982920	8629,31	5590	1907,51	55,10
2020	3558707	10293,29	5542	2092,60	60,40
2021	3974565	11434,60	5500	2134,50	60,60

Source: compiled by the authors based on [10]

Operating and other costs of the hotel business in Ukraine increased steadily until 2016. The decrease in costs since 2020 is to some extent a positive factor for this sector, but the reason for this phenomenon was the unstable economic and political situation in the country, the effects of the financial crisis, and, consequently, the decrease in customers, tourists, accommodation, and living space [8]. The highest share of costs in the hotel business enterprise structure is in hotels, as they offer long-term accommodation of hotel services consumers and must provide the most comfortable living conditions. It should be noted that there is a gradual improvement in the quality of the hotel stock and an increase in the living space of the rooms.

The income from the hotel infrastructure is generally much lower than the income from the sale of rooms. The set of additional hotel services depends on the established hotel class and similar means of accommodation, confirmed by the manager's established tariffs on numbers which at the same time reflects the general level of the hotel object profitability.

The average number of rooms is about 50% of the total floor space in a high-end hotel. The rest of the hotel is set aside for infrastructure as well as public areas. On average, in 4-5-star hotels around 50-70% of the financial flow is generated by hotel rooms, with the remaining 50-30% - by additional accommodations and services. Deviations depend on the class of the property, location, number of F&B services (Food & Beverage), size of the fitness area, etc. The main infrastructure elements that generate most of the income, experts traditionally call F&B and conference space. Much less income comes from additional accommodations, and services (transfer, translation services, laundry, etc.). If room revenues can vary between 70 and 90%, the infrastructure generates 30 to 50% at the most. Of course, there are examples when the infrastructure elements bring more profit than the room's sale, but they are due to the specifics of a particular market segment and the hotel concept [14].

First of all, the forecast indicators characterizing the level of income from services provided in hotels and similar accommodations for a short period of time were made using the Box-Jenkins method (ARIMA) as a tool of PPP Statistica [11, c. 61]. The Boxing-Jenkins process use makes it possible to build a fairly accurate and adequate short-term forecasting model, but due to the non-stationary to building a more accurate long-term forecast, this method requires improvement and study of the time series.

A forecast conducted by the Box-Jenkins (*ARIMA*) method for operating and other costs of hotels, similar accommodation, living area of all hotel rooms, and similar accommodation is shown in Figure 1.
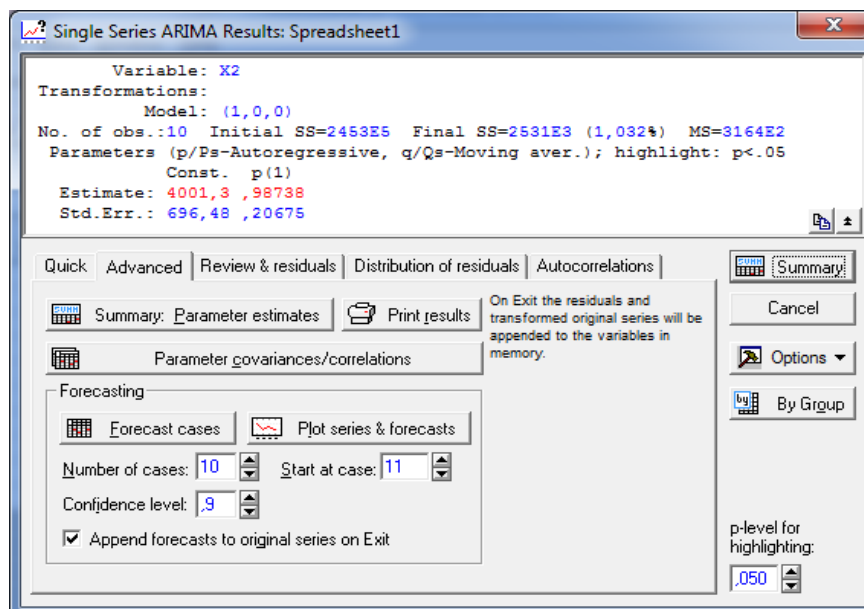

Figure 1: ARIMA results in a window to show operating and other costs of hotels and similar accommodation
Source: formed by the authors

According to the autocorrelation and partial autocorrelation functions behaviour, the most suitable indicators model will be the ARIMA model (1,0,0).

Paramet.	Input: X2 (Spreadsheet1) Transformations: none Model:(1,0,0) MS Residual= 3164E2					
	Param.	Asympt. Std.Err.	Asympt. t(8)	p	Lower 95% Conf	Upper 95% Conf
Constant	4001,347	696,4838	5,745069	0,000431	2395,253	5607,442
p(1)	0,987	0,2068	4,775719	0,001398	0,511	1,464

Figure 2: Estimates of ARIMA parameters for the operating indicator and other costs of hotels and similar accommodation
Source: formed by the authors

Figure 2 shows that the parameter estimations are significant (p<0,01). The balance analysis shows that thanks to the ARIMA & autocorrelation function procedure, a fairly adequate forecast model is formed for the operating and other costs of hotels and similar accommodation indicators. Similar actions were taken to the living area of all hotel rooms and similar accommodation indicators.

The resulting multiple regression data for the income indicator from hotel services provided and similar accommodation are shown in Figure 3.
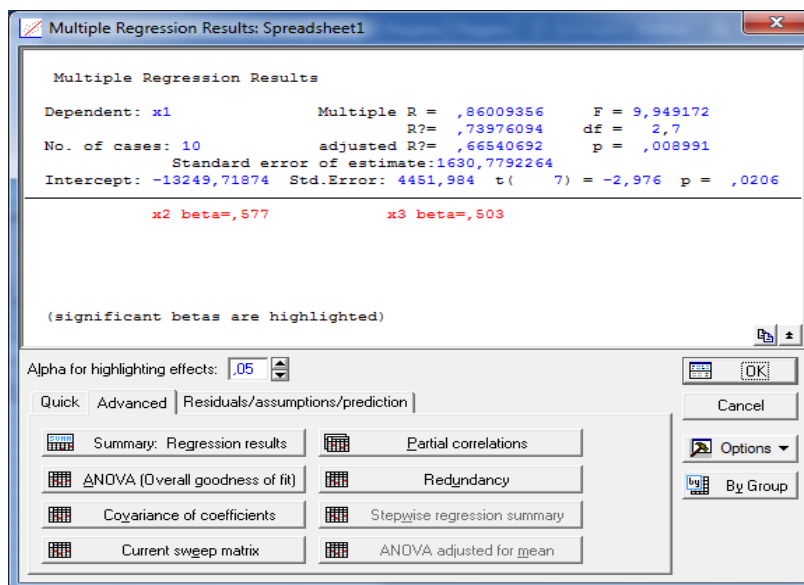

Figure 3: The data window results in the indicator income from hotel services provided and similar accommodation
Source: compiled by the authors

The constructed correlation matrix concerning the studied indicators will have the form (Figure 4):

Variable	Correlations (Spreadsheet1)		
	x2	x3	x1
x2	1,000000	0,264308	0,710034
x3	0,264308	1,000000	0,655805
x1	0,710034	0,655805	1,000000

Figure 4: Correlation matrix in the indicator income from hotel services provided and similar accommodation
Source: compiled by the authors

According to the result of the correlation matrix, the influence of each factor's impact on the hotel services provided and similar accommodation income is traced. Based on the statistical population

analysis, it is summarized its homogeneity and the proximity of the empirical distribution to the theoretical, in particular the absence of multicollinearity.

The parameters estimating the results of the econometric model for the indicator «income from hotel services provided and similar accommodation» are presented in Figure 5.

N=10	Regression Summary for Dependent Variable: x1 (Spreadsheet R= ,86009356 R?= ,73976094 Adjusted R?= ,66540692 F(2,7)=9,9492 p<,00899 Std.Error of estimate: 1630,8					
	Beta	Std.Err. of Beta	B	Std.Err. of B	t(7)	p-level
Intercept			-13249,7	4451,984	-2,97614	0,020627
x2	0,577008	0,199923	2,1	0,713	2,88615	0,023445
x3	0,503298	0,199923	5,2	2,060	2,51746	0,039959

Figure 5: Final standard regression statistics in the indicator income from hotel services provided and similar accommodation
Source: compiled by the authors

Figure 5 shows that p is less than 0,05, so the parameter estimates are significant. The analysis of parameters and balances shows that thanks to the multiple regression function of the Statistica package, a sufficiently adequate model of income forecast from hotel services provided and similar accommodation has been built.

One of the main indicators characterizing the density of correlation between selected factors, the closeness of the mathematical form of dependence on the indicator to the sample statistics is the multiple correlation coefficient. The correlation coefficient varies from -1 to 1 and if R> 0, then there is a direct dependence on the indicator between random variables and the independent variable, if R <0, then there is an inverse dependence on the indicator between these random variables [13]. For the constructed model R = 0.86, which indicates a close relationship between the selected factors and the econometric model's proximity to the data statistics.

During the econometric model construction, one of the problematic issues is the determination of the significance of the influence of the individual factors on the studied indicator. The significant factors influencing the studied indicator are determined by F-statistics: according to Fisher's criterion, F (2,7) = 9,9492, which significantly exceeds the tabular critical value and indicates the connection importance between factors; according to the Student's t-test, the obtained coefficient estimates are statistically significant, the standard error of the estimate = 1630,8.

According to the obtained parameters, the developed multifactor model will look as follows:

$$x_1 = -13249,7 + 2,1x_2 + 5,2x_3 \qquad (2)$$

Thus, the obtained econometric model, which is adequate for experimental data, allows us to carry out the economic analysis and obtain the value of the short-term forecast.

The change in the income level of hotels and similar accommodations is to some extent due to changes in the quantity and quality of hotel services and rising prices. The cost of accommodation in hotels and similar accommodations in Ukraine is significantly higher than the cost of accommodation in hotels of a similar class in the EU [13]. The high prices for hotel accommodation can be explained mainly by the small number of them in the hotel services market.

The cost of living in different categories of hotels in Ukraine ranges from $ 6-8 (in region hotel-type dormitories) to $ 300-400 in 4-star hotels. At the same time at the Premier Palace Hotel, the cost of living in the Premier Royal Suite is about $ 3000 [3].

Due to the demand localization for hotel services, it is worth noting that guests are concentrating on the lower price segments. Due to the reorientation towards organized customer groups, the workload in almost all hotel segments has increased slightly. In general, the domestic tourism growth share affects changes in the demand structure of hotel services, target audience, and consumer behaviour. Hotel assets are often part of a large company's diversified income strategy, especially in the case of foreign investors.

The resulting multiple regression data for the GDP amount indicator are shown in Figure 6.
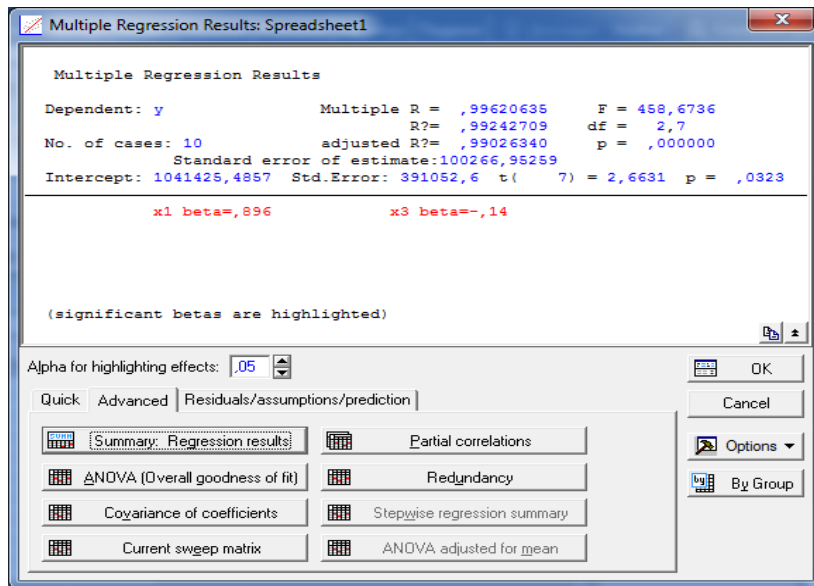
Figure 6: The window with data resulting in the indicator GDP amount
Source: formed by the authors

The constructed correlation matrix concerning the studied indicators will have the form (Figure 8):

Variable	Correlations (Spreadsheet1)		
	x1	x4	y
x1	1,000000	-0,693871	0,991322
x4	-0,693871	1,000000	-0,758799
y	0,991322	-0,758799	1,000000

Figure 7: The correlation matrix in the indicator GDP amount
Source: compiled by the authors

According to the correlation matrix result, the influence of each factor on the country's GDP is observed. Based on the statistical population analysis, can be summarized its homogeneity and the proximity of the empirical distribution to the theoretical, in particular the lack of multicollinearity.

The estimating parameters results of the econometric model in the indicator «GDP amount» are presented in Figure 8.

	Regression Summary for Dependent Variable: y (Spreadsheet1 R= ,99623956 R?= ,99249326 Adjusted R?= ,99034847 F(2,7)=462,75 p<,00000 Std.Error of estimate: 99828,					
	Beta	Std.Err. of Beta	B	Std.Err. of B	t(7)	p-level
N=10						
Intercept			1052244	391582,6	2,68716	0,031214
x1	0,894440	0,045850	322	16,5	19,50777	0,000000
x4	-0,138419	0,045850	-13682	4532,1	-3,01893	0,019416

Figure 8: Final statistics on standard regression in the indicator GDP amount
Source: compiled by the authors

Figure 8 shows that p is less than 0,05, so the estimated parameter is significant.

For the constructed model R = 0,996, which indicates a close relationship between the selected factors and the proximity of the econometric model to the sample statistics. According to Fisher's criterion F (2,7) = 458,67, which significantly exceeds the tabular critical value and indicates the importance of the factor's connection; according to the Student's t-test, the obtained coefficient estimates are statistically significant, the standard estimate error = 1003E2.

The parameters and balances analysis show that due to the multiple regression function of the Statistica package, a forecasting sufficiently adequate model for the country's GDP has been built.

According to the obtained parameters, the developed multifactor model will look like this:

$$y = 1052244 + 322x_1 - 13682x_4 \qquad (3)$$

Taking into account the mathematical operations performed according to the built model, we will make a forecast of the income level from hotel services provided and similar accommodations, and the GDP.

4. Experiment, results and discussion

The econometric model is used to forecast the impact of operating and other costs and living space of all hotel rooms and similar accommodation impact on the income from services provided in hotels and similar accommodations (Figure 9).
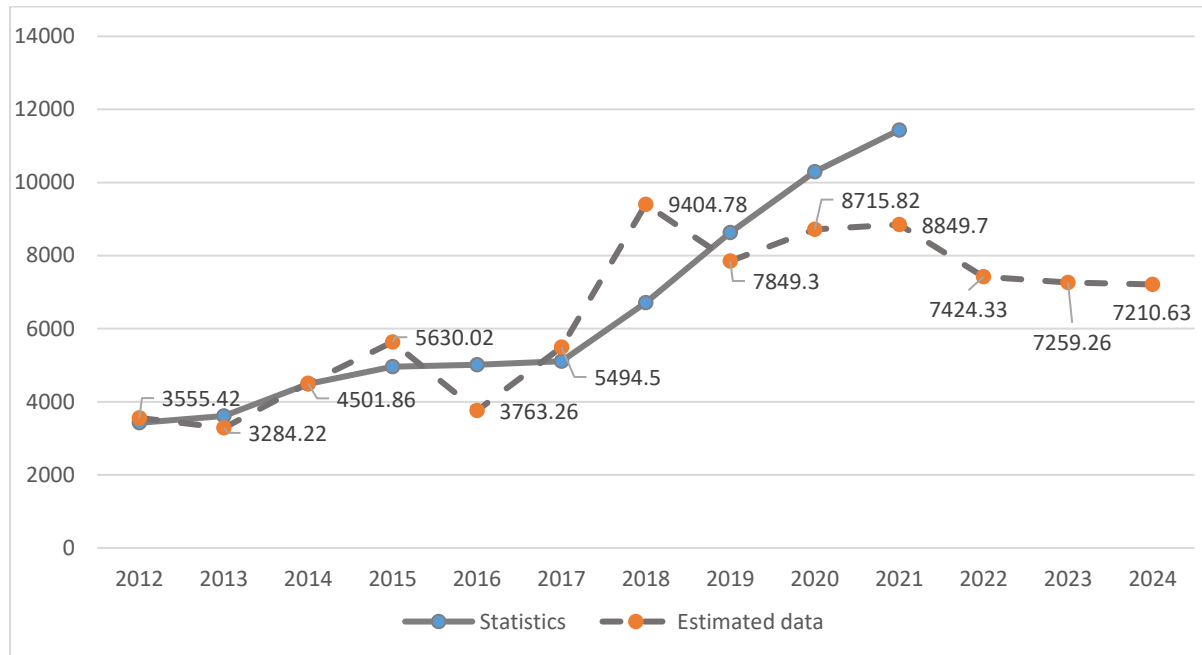

Figure 9: Income level dynamics from hotel services provided and similar accommodation
Source: compiled by the authors

The results show that the level of income from hotel services provided and similar accommodation will gradually decrease in the future. The hotel business is strongly influenced by various internal and external factors: economic, social, geopolitical, legislative transformations, climatic conditions, and the dynamics of market conditions, including goods, services, and resources. Directly or indirectly, these factors determine the hotel and similar accommodation income amount, as an important indicator of development, due to price aspects in the hotel services market, services demand, and so on.

A significant part of the profitability of collective accommodation in Ukraine depends on the income of hotels and similar accommodation, in the structure of which the main share is due to the receipt of the sale income of rooms, and the provision of additional services. The financial and economic crisis in the country has led to a deterioration of living standards, lower social security and basic human needs, which at the same time leads to lower demand for hotel services, as such services are usually not essential goods, and virtually no stimulating the economy tourism sector development reduces an enterprises profitability in the hotel sector in general. To improve the hotel business state, government incentives for tourism and hotel development are needed through the development and implementation of national and regional hotel business development programs, monitoring the implementation of these programs, and creating appropriate conditions to attract investment in the hotel industry. To develop an econometric model and forecast GDP amount, consider the following indicators: incomes from hotel services provided and similar accommodation and the fixed asset's degree of depreciation.

Ukraine's economic development is influenced by underinvestment, high level of fixed assets degree of depreciation, reorientation of markets, etc. A comparison of the degree of depreciation of fixed assets

in Ukraine and the neighbouring countries shows that the degree of depreciation of fixed assets in Ukraine is almost two times higher than in Slovakia, i.e. 60.6% in 2019 and 35.5% respectively [3].

The fixed assets degree of depreciation includes such important elements for the hotel business as the fixed asset degree of depreciation of transport infrastructure, temporary accommodation and catering, information and telecommunications, construction industry, health and social services, arts, sports, entertainment, and recreation, wholesale and retail trade. Significant The fixed asset's degree of depreciation in related areas becomes a problem for other areas of the economy because economic development is characterized by a synergistic effect.

The econometric model is used to forecast the impact of operating and other costs of hotels and similar accommodations on the level of GDP (Figure 10).
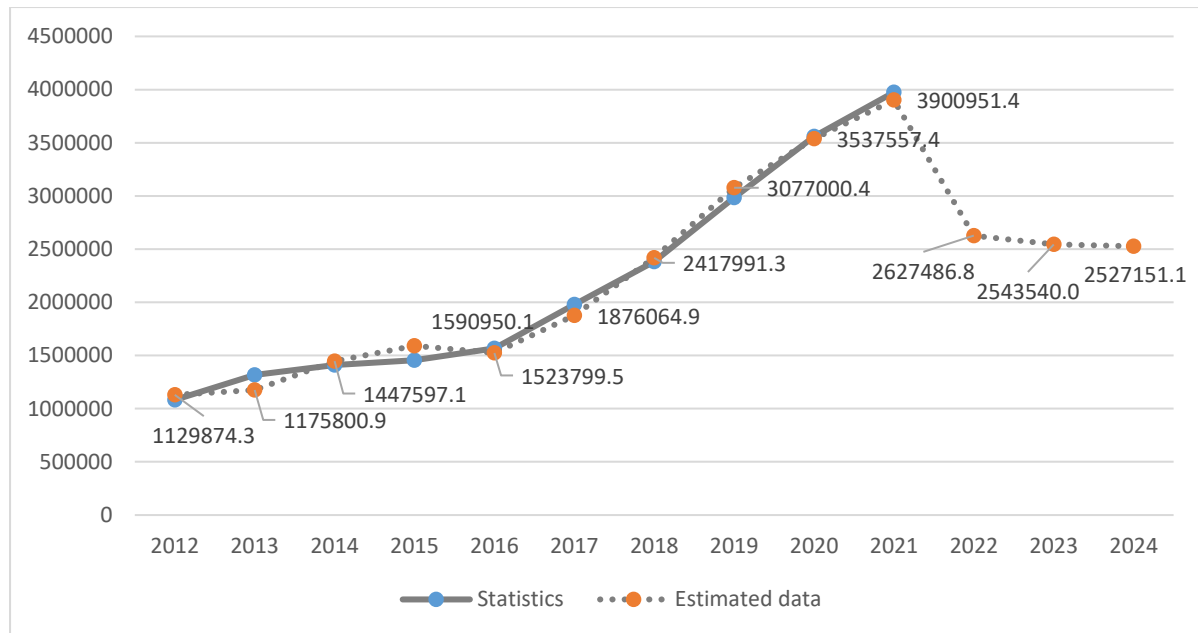

Figure 10: Dynamics of GDP amount with the forecast
Source: compiled by the authors

The development and implementation of innovations and the latest technological advances play an important role in the competitive market of the hotel sector, ensuring the compliance of hotel companies with European standards. The newest components size of the hotel logistics confirms the importance and complexity of the business entities. Ukraine needs to create hotel-type enterprises that can compete with high-economic performance branded hotels and ensure logistics improvement.

Thus, the obtained econometric model, which is adequate for experimental data, allows to conduct of economic analysis and obtain the value of the short-term forecast. The results of the research show that the GDP of Ukraine will be gradually on the decline in the future. The hotel business is a rapidly developing sector of the economy. The hotel sector accounts for 6% of the world's GDP and about 5% of all tax revenues [3]. The calculations show that stimulating hotel business development will affect the growth of Ukraine's GDP amount.

5. Conclusion

The hotel business development leads to a direct cost increase of customers (tourists) for accommodation and the use of vehicles contributes to the creation of new jobs. Supporting the hotel industry's functioning gives a sustainable boost to many economic sectors, and various activities, including transport infrastructure, information technology, trade, various facilities construction, agriculture and new technologies (innovations), beauty services and health, areas of various consumer goods production, etc. Thus, the hotel business intensification in the country has a positive impact on the region's economy, cities, and the state in general, on the social and economic development of the country. Using factor econometric modelling based on real statistical data, the degree of influence of

the components of the hotel business potential on economic growth in Ukraine and the country's GDP was assessed. Such scientific research allows us to identify the functioning state and dynamics of hotel business development and to outline problems and directions of their solution. Therefore, the application of machine learning methods is extremely important for the process of developing and implementing a development tourism policy, the hospitality industry, the formation of the strategic directions for the hotel industry development, and the hotel services market. At the same time, it helps to reflect the consequences, and the future hotel business results, taking into account input information analysis and expected development trends. The obtained forecast GDP amount data can help in the formation of various types of programs for state socio-economic development, and economic sectors in the short term, to assist government agencies in the effective policy process for hotel business development. On the basis of mathematical calculations, the authorities have to make fundamental decisions on the development of the hotel industry in the country.

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